COMPILATION

OF

PUBLIC DOCUMENTS AND EXTRACTS

FROM

REPORTS AND PAPERS

RELATING TO

LIGHT-HOUSES, LIGHT-VESELS, AND ILLUMINATING APPARATUS, AND TO BEACONS, BUOYS AND FOG SIGNALS.

1789 to 1871.

U. S. LIGHT-HOUSE ESTABLISHMENT.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1871.
AN ACT for the establishment and support of light-houses, beacons, buoys, and public piers.—(Statutes at Large, vol. 1, p. 53.)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all expenses which shall accrue from and after the 15th day of August, 1789, in the necessary support, maintenance, and repairs of all light-houses, beacons, buoys, and public piers erected, placed, or sunk, before the passing of this act, at the entrance of or within any bay, inlet, harbor, or port of the United States, for rendering the navigation thereof easy and safe, shall be defrayed out of the Treasury of the United States.

Approved August 7, 1789.

Circular to Superintendents of Light-houses.

TREASURY DEPARTMENT,
Revenue Office, March 21, 1815.

SIR: It being highly desirable that the light-houses of the United States, with the beacons, buoys, and public piers, and stakeages of channels, bars, and shoals, should be forthwith placed and maintained in a complete state of repair, I invite your early attention to this object, and request that you will, without delay, enable the Treasury Department, by the information which you may communicate, to take any necessary steps for its accomplishment, in addition to those already taken. The more effectually to accomplish this end, you will please to make a report of the actual condition of the establishment under your superintendence, with the suggestion of any deficiencies, and an estimate of the expense of supplying them. In case of repairs needed in any one light-house, which will not cost more than one hundred dollars, you will consider yourself now, or hereafter, authorized to make them without a special authority; in other cases, a particular allowance will be proper. As you are the established organ of correspondence on this head, the fullest and freest interchange of facts and suggestions, calculated to aid the interests of navigation, or economize the public expen-
diture, is not only desirable, but necessary. It is therefore invited, under the assurance that your communications shall receive an invariable attention.

You have been heretofore apprised of the contract entered into with Mr. Winslow Lewis, for fitting up the light-houses agreeably to his plan, the completion of which was interrupted by the late war. That you may the better understand its nature, and be the better enabled to discharge the duties to be performed by you in virtue of it, I subjoin a copy. Immediate measures will be taken to carry this object into full effect by Mr. Lewis, under the special direction of Henry A. S. Dearborn, Esq., collector of the port of Boston.

You will observe that, agreeably to the 6th article of the contract, Mr. Lewis is bound to produce a more brilliant light, with one-half the quantity of oil used in the former mode of lighting. To ascertain whether this effect shall be produced, it is requisite that the keepers should be careful in making regular returns of the oil on hand, and the quantity annually consumed, particularly observing the difference in the quantity consumed by the old and new lamps.

In addition to this information, to test the fidelity with which Mr. Lewis may have executed his contract, it will be necessary to give information to this office of the present precise condition of the apparatus fitted up by Mr. Lewis; whether and in what degree it has been injured by circumstances growing out of the war; for what time, and in what degree, the lights have been extinguished during the war; whether the oil, and to what extent, has been injured or wasted by such circumstances, and the time, (past or future,) when Mr. Lewis's lights were first used instead of the old ones, and the quantity of oil at that time on hand.

You will observe that the contract of Mr. Lewis does not involve the repairs of the light-houses, which is a trust especially reposed in the superintendents. As, however, the complete execution of the objects devolved on him may, in some cases, require such repairs to be made, it will be proper, under the limitations above specified, to co-operate with him by making them.

I am, very respectfully,

Commissioner of the Revenue.

Articles of agreement made on the twenty-sixth day of March, in the year of our Lord one thousand eight hundred and twelve, between Albert Gallatin, Secretary of the Treasury of the United States of America, of the one part, and Winslow Lewis, of Boston, in the State of Massachusetts, of the other part.

This agreement witnesseth, That the said Albert Gallatin, for and on behalf of the United States of America, and the said Winslow Lewis, for himself, his executors, and administrators, have mutually covenanted and agreed, as follows:

1st. That the party of the second part does hereby give, grant, sell,
and convey unto the United States, all his patent-right to the plan of lighting light-houses by reflecting and magnifying lanterns, including his patent-right for all the light-houses already built, or which may be hereafter built, in the United States, their territories and dependencies, wherever now or hereafter situated, including also those which have already been fitted on his plan, and all time and personal expenses, and all that is due him for fitting the same.

2d. That the party of the second part shall, on or before the expiration of two years, fit up all the light-houses in the United States, and all the light-houses that may hereafter be built, within two years from the date hereof, upon the aforementioned plan, and with the proper apparatus, and superintend the collecting of all materials, making all the apparatus, and conveying the same to the different light-houses.

The apparatus or clock-work for revolving the lights shall be fixed in such of the light-houses as may be designated by the Secretary of the Treasury of the United States, and all that shall not be thus directed are to have the apparatus only for fixed lights; and the number of lamps in the lanterns of each light-house shall be according to the direction or approbation of the Secretary of the Treasury of the United States.

3d. The party of the second part shall, and will, at his own cost and expense, keep all the apparatus which now is, or shall by virtue of the preceding article be, fitted in any and all the said light-houses, in complete repair for and during the term of seven years from and after the time the said apparatus shall be fitted, and deliver over, at the expiration of the term aforesaid, all the light-houses, fitted up according to the new and improved plan, to the United States, in good repair.

4th. The United States shall pay or allow to the party of the second part, for his patent-right as aforesaid, and for superintending the collecting of the materials, making the apparatus, and fitting up all the light-houses as aforesaid, the sum of twenty-four thousand dollars; that is to say, eight thousand dollars to be advanced on the contract being executed and transmitted to the Treasury, eight thousand dollars when half of the whole number of the light-houses shall be completely fitted on the aforesaid plan, and the remaining eight thousand dollars when the whole number of the light-houses, as aforesaid, shall be fitted and in complete operation, to the full approbation of the Secretary of the Treasury of the United States. It is hereby understood, that the expense of the materials, making the apparatus, conveying the same to the different light-houses, and fitting the same as aforesaid, other than for the time and personal expenses of the party of the second part, is to be borne by the United States.

5th. The United States shall pay or allow to the party of the second part at the rate of five hundred dollars a year for keeping all the apparatus aforesaid in repair during seven years, as above stated, and shall, moreover, pay and allow him for the wicks and tube-glasses which may be wanted, and with a sufficient quantity of which the party of the second part shall always keep all the light-houses aforesaid properly supplied, at the following rates, that is to say, three dollars per gross for wicks of the best fabric, and for tube-glasses for the lamps thirty-three cents each. And it is further understood, that in case of the
destruction of the apparatus in any of the light-houses, by fire, or other accident, or through the fault or neglect of the keeper, the expense of repairing or providing new apparatus shall be borne by the United States.

6th. In case that, owing to any defect in the aforementioned plan, or to the work to be prepared and fitted under the superintendence of the party of the second part not being properly executed, it should happen that the said plan and apparatus for light-houses should hereafter be found not to fully answer the purpose of giving a more brilliant light than appears from the present mode of lighting, or should fail in saving one-half of the quantity of oil now used at the said light-houses, the party of the second part hereby binds himself, if he shall fail in repairing the defects so as to answer the said purposes, to refund all the money that shall have been paid to him by the United States on account of his patent-right and superintending the fitting up of said light-houses, and to relinquish all sums which might be due to him for said patent-right and superintending as aforesaid, and also to reimburse to the United States all sums which may have been expended in fitting up the said light-houses on the plan aforesaid. But is is expressly understood that the party of the second part shall in no manner be responsible or accountable for any failure which shall be owing to accident, or to neglect on the part of the keepers of the light-houses, or any of them.

It is hereby provided that no member of Congress shall be admitted to any share or part of this contract or agreement, or to any benefit to arise thereupon.

In witness whereof, the said Secretary of the Treasury, on behalf of the United States of America, hath hereunto subscribed his name and affixed the seal of the Treasury, and the said Winslow Lewis hath hereunto set his hand and seal, the day and year before mentioned.

ALBERT GALLATIN,
Secretary of the Treasury.
WINSLOW LEWIS.

Sealed and delivered, by the party of the second part, in the presence of us.

WILLIAM ROWSON.
ANDREW McCCLARY.

Northern Lights.*

ALLERLY BY MELROSE, February 16, 1833.

LENS COMMITTEE—February 23, 1833.

Present: J. A. Macconnachie, Esq., James L. Amy, Esq., Andrew Murray, Esq., Archibald Bell, Esq.

The convener laid before the meeting the following communication from Sir David Brewster, in regard to the comparative merits of lens and reflector lights:

"I take the liberty of addressing you, as convener of the Light-house
Committee, on the comparative value and economy of lenses and reflectors, and of suggesting some additional experiments for exhibiting the superiority of the former. I need not mention to you that the most distinguished philosophers in the Institute, and the most celebrated engineers and naval officers in France have, on the authority of direct experiments, decided in favor of lenses, both as to effect and economy.

"The Academy of Science of St. Petersburg have done the same more than five years ago, and Sir John Herschel has lately published the following testimony in their favor: 'The light-house,' says he, 'with the capital improvements which the lenses of Brewster and Fresnel, and the elegant lamp of Lieutenant Drummond, have conferred, and promise yet to confer, by their wonderful powers, the one of producing the most intense light yet known, the others of conveying it undispersed to great distances.'—(Disc. on Nat. Phil., p. 56.)

"The superiority of lenses, however, is no longer a matter of opinion, for it was proved, in the presence of the committee, that a single lens was equal to at least nine reflectors.

"This lens, too, was only twenty-nine inches in diameter, and was of green crown glass. Had it been made of good flint glass, and been thirty-six inches in diameter, it would have been equal to at least fourteen reflectors, four being added for the increase of area, which is a matter of simple calculation, and one for the loss of light in the green glass. I shall not avail myself, however, of this undoubted fact, but shall take the result which was actually seen by the committee, namely, that one lens equals nine reflectors, and I shall apply it to the case of a revolving light.

"The revolving light with lenses will consist of two lenses placed opposite to each other, and illuminated by a single lamp between them. The revolving light with reflectors will consist of eighteen Argand burners, nine reflectors being substitutes for each lens.

"It being admitted that these two pieces of apparatus will give the same light, let us consider their comparative advantages:

"1st. The lens apparatus will be decidedly the cheapest in its first cost, and the lenses will never require to be renewed.

"2d. The lens apparatus will not require one-third of the labor in cleaning and arranging them daily for use.

"3d. The lens apparatus will not require so strong and powerful a piece of machinery to move it, from its inferior weight and its greater compactness.

"4th. The lens apparatus may be placed in a much smaller light-room, the eighteen reflectors requiring a very large space, and economy might thus be introduced in the erection of future light-houses.

"5th. The eighteen Argand burners will decidedly consume more oil than the simple compound burner used for the lenses; hence, it follows that the lens apparatus is in every respect better and more economical than the reflector apparatus.

"But in the above comparison I have omitted entirely the addition of the lateral lenses and mirrors which I proposed in 1811, and which were used in the French light-houses. These lenses and mirrors will enable us to take as much light from the compound burner (which other-
wise goes to waste) as will be equal to four reflectors at the very least; so that without the slightest additional expense, excepting the original cost of these small lenses, &c., we can give the lens apparatus a great superiority over the reflector apparatus.

"Let us now compare the lenses and reflectors in reference to the introduction of extraordinary illumination, which in fogs and in seasons of danger may be required.

"The means which may be thus resorted to are these: 1st, the Drummond light; 2d, the blue and signal lights; and 3d, any extra lamps which may be at the time in the light-house.

"In the lens apparatus the Drummond light can be introduced instantly, by merely putting the lime-ball in the place of the burner. In the reflector apparatus this is impossible. To produce the same effect the eighteen reflectors would require to be each fitted up with a Drummond light, the expense of which would be enormous, and for ordinary and extraordinary purposes the light-house would require in all thirty-six reflectors, to be as effective as the lens apparatus.

"In introducing the blue and red lights for occasional purposes, we have only to burn them on an iron plate or dish, placed either beside the burner or occupying its position. From the power of the red light to penetrate fogs, I consider it as an invaluable resource in light-houses. In the experiment which the commissioners witnessed, its brilliancy was fully equal to that of the lens apparatus. I need scarcely add that these signal lights cannot be introduced into reflectors.

"If the light-housekeeper is provided neither with the Drummond light nor the blue and red signal fires, he can at present do nothing to add a ray to his reflectors, even if he knows that in a dark and stormy night human life is exposed to danger. With the lens apparatus, on the contrary, he can surround the main burner with all the spare Argand burners in his possession, and thus convey a great quantity of additional light into the refracted beam.

"Hence, it follows, that the lens apparatus is far more intense than a reflector apparatus of the same size; that with the same intensity of light it consumes much less oil; that in reference to original cost, repairs, and renewals, it is more economical; that it requires a less expensive light-room, and demands much less time and trouble from the keeper, while it possesses the property (which reflectors never can have) of admitting every variety of resource in cases which demand extraordinary illumination.

"I have no scruple in stating that the introduction of the lens apparatus will occasion an annual saving in the expenditure of the board; but if this were not the case, and if much more oil were consumed by the use of superior lights, it would still be the duty of the commissioners to adopt it. No mining company uses the old steam engines of Savary and Newcomen, in order to save the additional expense of purchasing one of James Watt's. No astronomer continues to use the old refracting telescope because an achromatic telescope is a dearer instrument. In these cases scientific and pecuniary interests are alone concerned; but in the choice of lights, human life is involved, as well as national property, and a higher responsibility is therefore attached to their man-
agement. I trust, therefore, that the commissioners, now that they have witnessed the superiority of lenses, will not allow any considerations of economy (even if they did exist) to prevent them from introducing a system of illumination already established in other countries, and calculated to promote the just objects for which their board was instituted.

"In order to prove more fully the value of lens illumination, I beg to suggest the following experiments and calculations:

"1. Try the Drummond light in the focus of the lens, and compare it with the same light in the focus of a reflector.

"2. Try the blue and red lights in the focus of the lens.

"3. Compare a single reflector with the same Argand burner in the focus of the lens.

"4. Compare the quantity of oil consumed by one compound burner with that consumed by eighteen Argand burners of the common size.

"5. Compare the expense of a light-house erected for a revolving lens apparatus, with that of one erected for eighteen reflectors.

"6. Compare the expense of two lenses (£25 each in Paris) with that of eighteen reflectors, adding the expense of their frames and of the machinery for moving them.

"Before concluding these hurried observations, permit me to add, that the use of distinguishing lights is considered by every person as highly desirable, and that it is only with the lens apparatus that they can successfully be introduced. I would beg leave, also, to repeat what I urged on a former occasion, that coal gas should be employed in every light-house where there is accommodation for its proper manufacture. An immense saving would thus be effected, and a more perfect system of illumination obtained.

"J. A. MACHONCHIE, Esq., &c."

ALLERLY BY MELROSE, March 29, 1833.

My Dear Sir: As the experiments made on the Calton Hill afford sufficient data for guiding the opinion of the board, on the relative value and economy of lenses and reflectors, I beg you will submit to the commissioners at their first meeting, the following statement, respecting some important questions, to which they will no doubt speedily direct their attention:

1. In establishing a new light-house, should the method of illumination by lenses be adopted?

2. Would it be wise to dismantle every light-house in Scotland, and substitute lenses for reflectors?

3. Should gas be introduced in place of oil?

4. Should means be provided in every light-house for the occasional exhibition of powerful lights?

5. Should a new system of distinguishing lights be matured and adopted?

To all these questions I trust the commissioners will agree with me
in giving an affirmative answer. That the committee of the Royal Society will concur in the statement I am about to make, I cannot for a moment doubt; because scientific questions can admit of only one solution; but if, like other prophets, our opinions shall have no weight in our own country, I shall, for the satisfaction of the board, be able to support them by the concurring testimonies of the most distinguished professors in Cambridge and Oxford, and by the practical judgment of the most eminent scientific engineers of the present day.

1. In order to enable me to answer the first of the above questions relative to the introduction of lenses into new light-houses, I have obtained from M. Fresnel, of Paris, a detailed estimate of the expense of fitting up a light-house with the lens apparatus, including all the necessary machinery and utensils, and on the scale which is in use at the magnificent establishment of Corduan.

The optical part consists of nine lenses, thirty inches in diameter, nine smaller lenses, with their reflectors, for widening the main beam of light; and another piece of apparatus for collecting the light that falls below the lenses. The expense of this part of the apparatus is 16,500 francs, or £687 10s.

The mechanical part consists of all the frame-work and revolving apparatus, with three Carcel's lamps. The expense of this part, including the smaller utensils, is 9,500 francs, or £395 16s. 8d., making the total amount 26,000 francs, or £1,083 6s. 8d.

Now, the expense of a reflecting apparatus with twenty-four reflectors, is £1,387, making a saving of £303 13s. 6d. in favor of the lenses, or of £413, reckoning £110 as the value of the plate glass cavall in the lantern for lenses. This saving will be increased to £513, because £100 may be saved by substituting an invention of Mr. Oldham's for the Carcel lamps or by introducing gas.

If these twenty-four reflectors are arranged in groups of six, then the brightest light which at any one time reaches the eye, is that of six reflectors, which is repeated four times in each revolution; whereas in the lens apparatus we have a light equal to nine reflectors, repeated eight times during each revolution, besides the additional light of the eight smaller lenses, and that of the other piece of apparatus. Hence it is demonstrable that the lens apparatus is not only £413, or eventually £513, cheaper than the reflector apparatus, but gives a more intense and penetrating light.

But, independent of these enormous advantages, the lens apparatus is perennial, while the other is perishable, and requires to be renewed.

2. In answering the second question, respecting the propriety of dismantling every light-house in Scotland, and substituting lenses for reflectors, I shall treat the subject commercially, though I might at once solve the question, by affirming that if the lenses afford, as they have been proved to do, a more brilliant and penetrating light, they ought to be instantly adopted from motives of humanity, even if the board were to sustain a heavy loss. It is fortunate, however, that motives of economy and humanity are, in this case combined in favor of the change. In the following calculations I shall take a fixed light, such as that of the Isle of
May, and a revolving light similar to that of the Bell Rock, and I shall suppose that the apparatus at both these stations is perfectly new.

The Isle of May light-house has twenty-seven reflectors; I propose to substitute, in place of them, a lens apparatus which will cost £1,000, the sum which is saved by there being no revolving machinery being sufficient to purchase the additional lenses. Now the twenty-seven reflectors at present used will produce £567, and I estimate the value of the lamps, &c., at £50; so that the produce of the present apparatus will, at the very least, be £617, which, taken from £1,000, leaves £383 as the expense to be incurred in establishing the new system of light, which will be at least six or eight times more intense than those now in use. This outlay, however, is nothing when we come to consider the annual saving.

The consumption of oil per annum at the Isle of May, is 1,080 gallons, which, at six shillings per gallon, amounts to £324. But the lens apparatus requiring only one lamp, which consumes oil equal to fourteen Argand burners, (according to Mr. Stevenson,) will burn only five hundred and sixty gallons of oil, which amounts to £168. Hence there will be an annual saving in oil alone of £156, besides £10 more for glass chimneys and other articles; this annual saving of £166 will surely justify the commissioners in making an outlay at the Isle of May of £383.

If we now take a revolving light of 24 reflectors, like that of the Bell Rock, the advantage of changing it for lenses will be equally clear. The expense of the largest and most complete lens apparatus for a revolving light, like that of Corduan, as already in detail, is £1,083. The value of the silver in the 24 reflectors will be £504, which, with £45 for lamps, &c., makes £594, leaving an outlay of only £484 in order to give the Bell Rock light-house a scientific and an efficient system of lights, which will be seen at a much greater distance than the present ones, and through a hazy atmosphere, which will completely obstruct the lights now in use.

But this change will also produce a great annual saving. Twenty-four reflectors consume 960 gallons of oil, which will cost £288; whereas the lens lamp will consume only 560 gallons, which will cost £168—so that there will be an annual saving in oil alone of £120 or £130, including a saving in glasses and other articles. In reference to the economy of light-houses furnished with lenses, I may state to the board, on the authority of M. Fresnel, the highly important and startling fact, that the annual expense of the great light-house of Corduan, including light-house men's wages, oil, wicks, &c., is £395 6s.,* while the Bell Rock light-house costs the country £861 annually, on an average of four years, and the smaller one, at Tarbetness, £555 annually, on an average of three years.

3. I come now to the question of the substitution of gas for oil. In January, 1826, more than seven years ago, I urged the commissioners to make this great and obvious improvement; an improvement as valuable in point of economy as it is in reference to brilliancy of illumination. Experience, on a great scale, has already given its decision on

---

* Less than $1,800 per annum for Corduan light, fitted with a first-order lens.
this subject. Austria has, many years ago, lighted up with coal gas the
great light-house of San Salvore, on the coast of Istria, and the effect
of the gas far surpasses that from oil lamps. The details of the rela-
tive expense of gas and oil have been published by Professor Aldine;
but I shall trouble the board only with the grand result:
The annual expense of oil lights was ...................... 1,861 florins.
The annual expense of gas is............................... 982 "

Making a saving of........................................ 929 "

Exactly one-half of that of oil. If we include the interest on the
money advanced for the gas apparatus, which was 400 florins, the total
expense for gas annually is 1,332 florins, leaving still a saving of
529 florins, or nearly one-third of the expense of illumination by oil.

I may add, also, that two small light-houses at Dantzic are fitted up
with gas. One of them consists of a parabolic reflector 22 inches in
diameter, and the other of one 17 inches in diameter. Here, as in Istria,
the introduction of gas has been found to be a measure of great economy,
and the additional brilliancy of the lights at Dantzic was so great that
the inhabitants of Hela, where the gas was first lighted, attributed the
brilliant effect to a great fire in the city.

4. Seven years ago I suggested also the necessity of providing, in
every light-house, the means of exhibiting powerful lights in cases of
great emergency, and I have described, in my printed paper, the means
by which this can be done. The Drummond light is obviously well
adapted for this purpose, when placed in the focus of a lens,* but an
equally efficacious and much cheaper substitute for occasional purposes
has been suggested by Mr. Robinson, namely: the burning of blue and
red lights. I lately recommended the introduction of these lights into the
focus of the lens, and the Board will recollect the splendid effect which was
there produced by the red light, a light especially fitted for penetrating
a hazy atmosphere. The use of such lights is impracticable with reflect-
ors, and the facility and effect with which they can be used with lenses
is a new argument, if any were wanted, in favor of the latter.

5. During the late discussions in the House of Commons, Sir Edward
Codrington pointed out the disadvantages to seamen of numerous light-
houses, but these disadvantages exist only when the lights are not
properly distinguished from one another. Hence, it becomes a matter of
the highest importance, especially when light-houses have become numer-
ous, to establish a well-matured system of distinguishing lights. The
methods used in France do not afford a sufficient number of palpable
distinctions. The use of colored media, or of transparent plates that
produce periodical colors, or polarized tints, presents us with the best
means of supplying this desideratum. Experiments on which I have

* I need not mention to any person acquainted with optics that, in the bungled
experiments with the lens and Drummond light, on Thursday, the 21st, and Friday,
22d March, the lens was so misplaced that the brilliant part of the column never
reached the eyes of the spectators, who saw only the penumbra; otherwise, the Drum-
mond light, with the lens, would have greatly exceeded that by the reflector. To
prove this by ocular demonstration, the two lights, at a moderate distance, should be
thrown into a room, and their radiative intensities actually measured.
long been engaged, on the absorption of light by solid fluids and gases, have led me to various results, which are peculiarly applicable to the present purpose. I have in this way succeeded in impressing upon any given light a numerical character which no change can take from it, and which can be recognized by looking at the light through a small and cheap instrument made for the purpose. If the commissioners should desire to witness the effects of this and other methods of distinguishing lights, an apparatus could, with the assistance of Mr. Adie, be easily constructed. But if these new plans should not meet with the approba-
tion of the Board, the introduction of lens illumination will furnish ample means of obtaining distinguishing lights, by a well-arranged succession of light and darkness.

Before concluding this letter, permit me to make a few remarks on the proposal to erect a lens apparatus at Inchkeith. As a light-house of the first-order is not required at this station, it might, under ordinary circumstances, be sufficient to replace the present very inefficient apparatus by lenses of half the area and half the price (viz: £25 each) of the largest, and to employ only a burner of two wicks, which is equal to three and a half Argand burners.

This apparatus would consume only one-fourth of the oil now used by the seven Argand burners, and would give a light several times more intense. Such an apparatus would cost about £500. But as I presume it to be the object of the board to erect one of the best lens apparatus, as a guide for their future proceedings, I earnestly recommend to them to have the apparatus complete, with all the modern improvements, and especially to light it with coal gas. The expense of the gas apparatus will be paid by its own savings in a few years, and that of the lens apparatus will not greatly exceed £1,000. But, whatever was its cost, it would be creditable to the metropolis of Scotland, and most useful to the navigation of the Frith of Forth, which is frequently beset with fogs, to have at Inchkeith a light-house of the first order in point of magnitude, and of the highest character in point of science.

I have, &c.,

D. BREWSTER.

To J. A. MACONOCHIE, Esq.,
Convener of the Lens Committee.

FRENCH LIGHT-HOUSE ADMINISTRATION.

PARIS, April 30, 1834.

The light-houses, for the most part, existing upon the coasts of France before the Revolution, had been built and were managed by commercial bodies.

A law of the National Assembly, dated the 15th September, 1792, centralized the light-house, beacon, buoy, and sea-mark service by placing it under the superintendence of the Minister of Marine, and by charging the Minister of the Interior with the execution of the works agreed upon
for this service by the two departments. A consular order, dated the 11th June, 1802, confirmed the law of the 15th September, 1792, concerning light-houses. An imperial decree of the 7th March, 1806, caused the light-house, buoy, sea-mark, and beacon service to be attached to the official duties of the Minister of the Interior, and from that time they were placed under the immediate direction of the Commissioner of Roads and Bridges. This decree, nevertheless, requires the Ministers of the Interior and of Marine to advise with each other in reference to the establishment of any new light-houses or sea-marks, and this arrangement gave rise to the Light-house Commission, which was established in 1811. In 1825, at which period the system of lenticular lights was definitively adopted for lighting the coasts of France, this commission is found to have been composed as follows:

M. Beequey, counsellor of state, director general of roads and bridges, president of the Commission.
M de Prouy, inspector general of roads and bridges, member of institute.
M. Tarbé de Vaux Clairs, inspector general of roads and bridges, counsellor of state.
M. Igauzin, inspector general of hydraulic works at the sea ports.
M. Rolland, inspector general of naval architecture.
M. Halgan, rear admiral and counsellor of State.
M. de Rossel, rear admiral, director of the repository of charts and plans of the royal navy, member of the Institute.
M. Beautemps Beaupré, hydrographer in chief of the royal navy, member of the Institute.
M. Arago, astronomer and member of the Institute.
M. Matthieu, astronomer and member of the Institute.
M. Fresnel, principal engineer of roads and bridges, member of Institute, secretary of the Light-house Commission.

It was by this Commission that all the projects and measures adopted since its institution, for the improvement of the light-house and sea-mark service, were examined and discussed; and one of its most important labors was the study and examination of the general system, adopted in 1825 upon the report of the Rear Admiral de Rossel, for lighting the coasts of France.

PRESENT ORGANIZATION OF THE LIGHT-HOUSE SERVICE.

The organization of the light-house service, now in force, (1834,) is, briefly, as follows:
This service is attached to the official duties of the Minister Secretary of State for the Department of the Interior, and is altogether under the direction of the counsellor of state, charged with the general administration of the roads and bridges. In each naval district the prefect, principal engineer, assistant engineers, and superintendents of roads and bridges, direct or supervise, in the sphere of their respective offices, all that relates to the management of light-houses, sea-marks, and beacons in the neighborhood.
The light-house service, considered collectively, embraces lighting, reparatory works, and the formation of new establishments.

Light service.—The light service of the coast of France has been contracted for (reckoning from the 1st July, 1830) for nine years. To encourage competition, the contract was divided into three distinct lots, severally corresponding to the Channel, Atlantic, and Mediterranean coasts.

In consideration of the prices determined on by adjudication, each contractor is bound to supply all the wants of the light service, and order all minor repairs of the apparatus and lamps.

The light-house keepers are appointed and paid by the contractor, subject, however, to the approval of the engineers, who may also require their dismissal. The contractors are paid quarterly by the prefects, from certificates signed by the principal and assistant engineers.

The cost of lighting the coasts of France amounts this year, exclusive of official charges, to 200,000 francs. It will amount to 400,000 francs as soon as the lights are completed and improved in conformity with the orders given by the administration.

Reparatory works.—The repair or restoration of light-houses, after being authorized by the director general, is, with roads and bridge works, executed under the superintendence of the district administrations.

New Establishments.—In the formation of new establishments, the following routine is observed:

The engineers of the district where the new edifice is about to be erected make a draft of the plan, in conformity with the basis previously determined on by the light-house commission. The plan is forthwith submitted to the commission, which confines itself to the inquiry, as to whether the wants of the service, nautically, or otherwise reported on, and constituting the main objects, have been complied with. It is then presented to the council of roads and bridges to receive their estimate, founded on the reports made of the architectural arrangements of the system of building and of the calculated expense. After receiving the approbation of the director general of roads and bridges, and of the Minister of the Interior, the plan is sent to the prefect of the district, who proceeds to the public adjudication (contract) of the works, and entrusts the engineers with the execution of them. The lamps and light apparatus are made at Paris, under the care of the engineer-in-chief, secretary of the light-house commission.

The establishment of new light-houses is announced to the public several months beforehand, by means of handbills, and advertisements inserted in the Moniteur newspaper. The administration, moreover, publishes annually a summary description of the light-houses and lights (fanans) on our coasts, and causes five or six thousand copies to be distributed amongst French and foreign navigators. The whole of the expense (with the exception of the cost of lighting a very small number of lights of purely local interest) connected with the light-house service, are supplied from the public treasury. The administration of the customs of France does not levy any especial light-house duty upon maritime commerce. This duty, which was abolished by the law of the
18th October, 1798, is, at the present time, included with the tonnage duty, which all vessels pay upon their arrival in port.

LO. FRESNEL,
Engineer-in-Chief and Secretary
of the Light-house Commission.

------------------

TREASURY DEPARTMENT,
Fifth Auditor's Office, December 15, 1835.

SIR: I perceive by a Mobile paper which I received this morning, that the Mobile Point light has been refitted by you as a revolving light. As the Pensacola light is a revolving light, and not many miles distant from that at Mobile Point, the changing of the latter from a stationary to a revolving light, is complained of as an injury to navigation.

In my arrangement with you for fitting up the Mobile Point light last summer, it was not expected or contemplated that you would refit it as a revolving light, and I am very sorry that you have done so.

Will you be good enough to state to me the reasons for changing this light from a stationary to a revolving light?

I am, &c.,

S PLEASONTON,
Fifth Auditor and Act. Com'r of the Revenue.

WINSLOW LEWIS, Esq.

------------------

BOSTON, December 22, 1835.

SIR: Your letter, under date of the 15th instant, has been received, wishing me to state my reasons to you for refitting the light-house at Mobile Point as a revolving light. When I made the proposition to you to refit the light, it was my intention to do it in that manner which would produce the greatest light in the United States. To do this, it required that the lamps should be so placed as to bring the focus of the greatest number of reflectors practicable to the eye of the mariner at one view. This could not be done on a circle, as a fixed light. I fitted the chandelier so as to place the lamps on the three sides of a triangle, which would bring seven focuses in view at one time; the triangle to revolve round once in every three minutes, giving the greatest power of light once in every minute. And the lamps are so arranged, that when you approach the light within ten miles distance, it is seen all the time. The expense to me, in fitting the light in this manner, is more than it would have cost to have fitted it as a fixed light—was over four hundred dollars. The distance between Mobile and Pensacola light is about forty five or fifty miles; a greater distance than there is between many of our revolving lights on the coast, which are fitted exactly
alike. Pensacola light is a small revolving light, with five lamps on each side of an oblong square. When first seen, at the usual distance, the time of darkness is four times to that of light; as you approach it within ten miles, the time of light and darkness is equal; when within ten miles of Mobile light, it can be seen all the time. The magnitude of the Mobile light is so different from that of Pensacola, that to mistake one for the other would be like taking a star for the moon. From what experience I have had, I think the light at Mobile is now fitted in a manner that would designate it from any other on the American coast, and produce the greatest light. The light-house on the Isle of Shoals, in New Hampshire, is revolving; at Wood Island, in Maine, the same; the distance between them, thirty miles. Cape May and Smith’s Island lights are both revolving; fifty miles between them. Gay Head and Point Judith, both revolving; thirty miles between them. Race Point, Cape Cod, is a small revolving light, in every way the same as Pensacola. Boston light, forty-two miles from it, is revolving. I have never heard of any injury sustained by navigation by mistaking any one of these lights for another. I must again repeat, that my motive for having the light at Mobile to revolve, was to get the greatest possible power of light, and to have it so planned that it could hardly be within the scope of possibility to mistake it for any other; in this, I think I have succeeded. I have seen the editorial remarks in the Mobile paper. With those unacquainted, all revolving lights are supposed to be alike, when the one now at Mobile is as different from that at Pensacola as the different arrangements of the lamps could possibly make them; and this will be acknowledged by navigators as soon as they become acquainted with them. In all that I have done with light-houses, I have never lost sight of the safety of navigation, nor ever recommended any alteration that would endanger it. I now enclose you the evidence required in your letter of the 24th of June, as to the goodness of the light:

1st. A certificate from Captain Belton, commander of the fort, having charge of the light.

2d. A certificate from seventy-five masters of vessels, with one from the officers of the revenue cutter.

3d. A certificate from the deputy collector, (the collector being absent,) that the names of the shipmasters were commanders of vessels then in that port.

4th. A certificate from eleven pilots, which, I presume, will be deemed sufficient evidence that I have performed everything in my letter stated to you, dated the 29th of June last. If so, your instructions authorizing Mr. Henshaw to make the payment, will be particularly acceptable at this time, having suffered by the recent fire in New York, at least so far as to suspend the payment of a considerable sum due me from a house there, who have lost all their property in the conflagration.

I have the honor to be, very respectfully, sir,

Your obedient servant,

WINSLOW LEWIS.
LIGHT-HOUSES, BUOYS, &c.

Letter from the Secretary of the Treasury, transmitting information upon the subject of executing the law for building Light-houses, Buois, &c.

DECEMBER 14, 1837.—Referred to the Committee on Commerce.

TREASURY DEPARTMENT,
December 13, 1837.

SIR: The undersigned has the honor to report, that the duties imposed on him by the second section of the act of Congress approved on the 3d day of March last, "making appropriations for building light-houses, light-boats, beacon lights, buois, and dolphins, for the year one thousand eight hundred and thirty-seven," engaged his early attention. On the 6th of that month, a communication was made, with a view to the immediate action of the Navy Department in relation to the subject.

The Board of Navy Commissioners soon proceeded, and caused examination to be made, and reported their opinion, as required, to this Department. The undersigned immediately thereafter gave such directions as were necessary to carry the law into effect. He now encloses the report of the Fifth Auditor, showing in detail the progress since made in the several works, and begs leave to invite to its suggestions the early attention of Congress.

The subject of additional aid in performing the business committed to the charge of that officer, urged at the close of his report, seems also to deserve the consideration of Congress, and to require a provision which will enable him to discharge the duties of the office with that promptness and despatch which the good of the public service demands, and with which he is anxious they should at all times be executed.

I am, very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

Hon. J. K. Polk,
Speaker of the House of Representatives.

TREASURY DEPARTMENT,
March 6, 1837.

SIR: I herewith transmit to you a copy of the act making appropriations for building light-houses, &c., approved the 3d instant. I request you will open a correspondence with the Navy Department, and request that the Navy Commissioners may be instructed to adopt the necessary measures to enable them to report to this Department, as provided in the second section of the act, at the earliest day practicable.

I am, very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

S. Pleasonton, Esq., Fifth Auditor.
TREASURY DEPARTMENT,
Fifth Auditor's Office, November 8, 1837.

SIR: In the act of Congress of the 3d March last, "making appropriations for building light-houses, light-boats, beacon lights, buoys, and dolphins," was a provision that, before any of the improvements should be commenced, the Board of Navy Commissioners should cause an examination to be made, for the purpose of ascertaining whether the safety of navigation required any additional facilities, and, if so, what was most suitable for each place, and to report their opinion in regard to all such places to the Secretary of the Treasury, who should proceed with the work so recommended; and that if the said board should be of opinion that the said improvements were not needed, no further proceedings should be had, and their opinions, with the facts, should be reported to Congress.

As many of the objects contemplated by the act were considered of great importance, and all of them together involved an expenditure of nearly a million of dollars, I have thought it would be acceptable to the two Houses of Congress to be informed of what has been done under the authority of the act. With that view, I have the honor to make the present communication, promising that it is considered the duty of the Navy Board, under the law, to report the particular reasons which governed them in rejecting the several objects of appropriation of which mention is here made.

* * * * * * *

[Extracts.]

The Gedney channel has been buoyed out, under the direction of Lieutenant Gedney himself.

The erection of the light-house at Flynn's knoll has been assigned by law to the engineer department. A contract has been entered into for building a floating light to be stationed off Sandy Hook, of two hundred and thirty tons, for fifteen thousand nine hundred dollars, being nine thousand one hundred dollars less than the sum appropriated. This vessel is to be finished by the first of January next, and so fitted up as to afford accommodations for extra seamen, whom merchants and underwriters may think proper to put on board, in winter, to aid vessels on the coast which may be in distress, and will also afford accommodations for pilots.

A skilful engineer has been employed to examine the Romer shoal, and to furnish a plan and estimate of the beacon which is considered necessary there. A suitable beacon, according to his estimate, will cost twenty-five thousand dollars—ten thousand more than the appropriation. I would recommend that an additional appropriation of the latter sum be made, and also that authority be given by law for causing the work to be done by a competent engineer; it being unsafe to assign a work of such difficult execution to the lowest bidder, as is done in ordinary cases.

For the light-house at Esopus meadows, on the Hudson river, three thousand dollars only were appropriated: it will require at least six thousand dollars; and, consequently, nothing has been done in relation to it. The proper site is inundated at high tides, rendering it necessary
to place the building on a pier so strong as to resist the floating ice in the spring of the year.

* * * * * * *

For Robbin's reef, which is seen from the city of New York, I was desirous of having a light-house both durable and handsome; the foundation being in water which rose and fell with the tide some eight or ten feet, and exposed in the winter season to floating ice, it was found necessary to form it of granite, forty-eight feet diameter, with an elevation of eighteen feet; upon this the tower will be placed, of the octagon form, built of hewn granite, with accommodations in the different stories for the keeper and his family. A contract has been entered into for erecting the building upon this plan, and with this material, for the sum of thirty-four thousand nine hundred dollars; and for fitting up the same, six hundred and eighty dollars; the work to be completed by the middle of October, 1838. The appropriation, it will be recollected, was fifty thousand dollars.

The Navy Commissioners have approved of the measure of building a light-house on Carysfoot reef, Florida, if the foundation should be found to be such as to admit of it. I have consequently despatched an engineer to that place to examine the foundation, and, if eligible, to report to me a plan and estimate of such a light-house as would best suit this particular situation. In case a light-house is built there, the floating light now stationed near the reef may be removed to some other station.

* * * * * * *

The existing Light-house Establishment consists of two hundred and eight light-houses, and twenty-six floating lights.

Of the former, one hundred and fifty-three have been built under the direction of this office, as well as the entire number of floating lights, since the year 1820; there having been but fifty-five light-houses at that period, when I took charge of it. I take great pleasure in stating, that, in general, it is in a perfectly satisfactory condition, and conducted upon a system at once efficient and economical. The lamps and parabolic reflectors of Mr. Winslow Lewis, which are employed in our light-houses, are found to emit a light which can be seen from fifteen to twenty, and even thirty miles, according to the size of the reflector and the state of the atmosphere. This is as far as is desirable, and, it is believed, farther than the lights of either England or France are visible.

In erecting the buildings, the plans of which are formed at this office, care is always taken to employ brick or stone, where the foundation will admit of those materials, and to employ suitable mechanics to superintend the work, day by day, as it progresses, in order that the contractors may not use bad materials or slight the work. The steps, whether the buildings are stone or brick, are generally made of stone, so as to render each building fire-proof. The dwelling-houses of the keepers are made uniformly alike, viz: thirty-four by twenty feet; one story of eight feet divided into two rooms, with lodging rooms above; to which is added a kitchen. To the south, a piazzza is allowed in addition.

The buildings are always erected by contract. Proposals are invited by public advertisement, and the lowest offer is always accepted, unless the person making it has previously deceived me; in which case, his bid
is set aside and not considered. No payment is made until the work is satisfactorily done, which, with a daily superintendent, affords sufficient security that the work will be well done.

Town classes of buildings have been adopted by this office; the smallest of which is thirty feet high, and the largest sixty-five feet high, independently of the lantern.

No wooden buildings, except two or three upon piers, have been suffered to be put up whilst the establishment has been under my charge; preferring, in cases where the appropriations were too small, to postpone the erection of the buildings until such additional appropriations could be obtained as would enable me to erect permanent and substantial buildings.

Periodically, proposals are invited by public advertisement, and a contract entered into, generally with an extensive oil dealer, to continue in force for a period of five years, for the supply of the necessary quantity of summer and winter strained oil, for all the light-houses, and for keeping all the apparatus in complete repair. By the last contract, which will expire on the first of January, 1838, and of which I enclose a copy, it will be seen that the sum paid by the United States was thirty-one dollars and ninety-eight cents per lamp. It will be perceived, also, that the contractors for supplying oil and keeping the apparatus in repair are bound to make a report directly to this office, annually, as to the condition of each light-house, and the conduct of the keeper.

If repairs are required to the buildings, they state the fact in their reports; and if the keepers are inattentive to the apparatus, the fact is also stated. On receiving these reports, instructions are given to the different superintendents to cause the necessary repairs to be made forthwith, and to reprimand the keepers, if in any cases it is necessary.

Besides this means of information as to the state of the light-houses, the several superintendents are required to examine them at least once a year, and to report their condition. Cutters are occasionally, also, sent along the coast, the captains of which are instructed to examine them, and report the situation of each.

For two or three years past I have submitted to Congress, in my annual estimates, the sum of two thousand dollars, to enable me to employ two additional clerks upon this branch of my business, which has become of such magnitude and importance that the force now employed upon it is altogether inadequate, being two persons only. The recording of contracts is several years in arrear, and that of the current correspondence of the office is, and must also remain, considerably in arrear. From some cause with which I am unacquainted, this aid has not been allowed me. I beg leave again most respectfully to bring the subject to the attention of the National Legislature, and to assure it that justice cannot be done to this most important branch of the public service, if this aid is longer denied me.

I have the honor to be, very respectfully, sir,

Your obedient servant,

S. PLEASONTON,

Fifth Auditor, and acting Commissioner of the Revenue.

Hon. Levi WOODBURY,
Secretary of the Treasury.
Circular to Superintendents of Light-houses.

Treasury Department,
Fifth Auditor's Office, February 8, 1833.

Sir: Messrs. Cornelius Grinnell, jr., & Co's contract for keeping the light-houses and beacon lamps supplied with oil, &c., having expired at the close of the last year, a contract has been entered into with Charles W. Morgan, Samuel Rodman, jr., William R. Rodman, and Edward Merrill, of New Bedford, for keeping the respective light-houses and beacon lamps supplied with oil; and for keeping in good repair all the lamps, reflectors, and apparatus, fitted in the light-houses and beacons; and also for supplying them with a sufficient quantity of wicks, tube-glasses, buff skins, and whiting; a copy of which is annexed for your guidance and information.

To ensure the faithful execution of this contract, your attention is respectfully requested to the following objects:

In case there should at any time be a deficiency in the quantity of oil, or other articles, it will be the duty of the keepers to advise you of the circumstance, and of yourself to advise this office, and also to inform the contractors.

Agreeably to the 2d and 3d articles, the contractors are, at their own cost, to keep in repair all the lamps, reflectors, and apparatus, oil butts, heaters, clock-work, &c., and to supply all the tube-glasses, wicks, buff skins, and whiting. Every expense, therefore, relative to those objects, must be paid by them.

To carry the provisions of the 9th article into effect, the keepers must keep accurate statements of the time during which the lights may be suspended, and transmit them to the superintendents, in order that they may be included in their annual reports to this office.

From the information furnished by the quarterly reports to you, of the keepers, and such other as may be at your command, you will be pleased, on the first day of January in each year, to make out and transmit to this office a statement of the preceding year, which shall specify the quantity and kind of oil on hand at its commencement; the quantity and kind of oil received during the year; the quantity and kind consumed during the year, and the quantity and kind remaining on hand at the close of the year; the character and condition of the oil when received from the contractors, and, at the date of the last report of the keeper, the number of lamps, lenses, and reflectors, in the light-house; the time during which, and the cause for which, any of the lamps may not have been used, with their number, and also the number of tube-glasses, wicks, and buff skins on hand at the commencement of the year, the number received and used during the year, and the number remaining on hand at the close of the year.

You will be particularly careful to require the contractors to fulfil their engagements, in all respects, in relation to the light-houses under your charge, and in case of default on their part, you will state the fact without delay to this office. You will likewise state your opinion of the
conduct of each keeper, and will admonish them from time to time of the
importance of strict attention to their duty.
I have the honor to be, respectfully, sir,
Your obedient servant,
STEPHEN PLEASONTON,
Fifth Auditor, and acting Commissioner of the Revenue.

Copy of Articles of Agreement, made on the fourth day of December,
in the year of our Lord one thousand eight hundred and thirty-two,
between Stephen Pleasonton, Fifth Auditor of the Treasury of the
United States, and acting Commissioner of the Revenue, of the one
part, and Charles W. Morgan, Samuel Rodman, jr., William R.
Rodman, and Edward Merrill, all of New Bedford, in the State of
Massachusetts, of the other part.

This agreement witnesseth, That the said Stephen Pleasonton, for and
in behalf of the United States, and the said Charles W. Morgan, Samuel
Rodman, jr., William R. Rodman, and Edward Merrill, for themselves,
their heirs, executors, and administrators, have mutually covenanted
and agreed as follows:

1. The party of the second part shall keep all the light-houses now
built in the United States, and all others that may be hereafter built and
fitted up, agreeably to Winslow Lewis's patent lamps and reflectors as
now used, together with the beacon lamps, supplied with a sufficient
quantity of best spermaceti strained oil, for the consumption of the
lamps, at their own expense, from the first day of April to the first day
of December, and a sufficient quantity of best winter pressed oil, from
head-matter, from the first day of December to the first day of April,
each and every year, for and during the term of five years, from the
first day of January, anno Domini one thousand eight hundred and
thirty-three.

2. The party of the second part shall and will, at their own cost and
expense, keep in good and complete repair all the lamps, reflectors, and
apparatus, fitted in the light-houses aforesaid, and all the oil butts, oil
heaters, clock-work, wick boxes, tube boxes, hand lanterns, cannisters,
torches, oil feeders, oil carriers, frames, diamonds, &c., for and during
the term of five years aforesaid; and shall deliver over, at the expira-
tion of the term aforesaid, all the light-houses fitted up, with all the
apparatus and articles above enumerated, to the United States, in good
repair: Provided, nevertheless, if said apparatus described in the above
article be not in good repair (which shall be determined by the returns
of the superintendents to the office of the Fifth Auditor) when the party
of the second part takes possession of the same agreeably to the terms
of this contract, said apparatus shall be put in good repair at the expense
of the United States.

3. The party of the second part shall and will also, at their own
proper cost and expense, supply all the tube glasses, wicks, buff skins,
and whiting, which may be necessary for the consumption of the light-houses for and during the term of five years aforesaid.

4. The United States shall pay to the party of the second part, in full satisfaction for the performance of the stipulations by them entered into as aforesaid, at the rate of thirty-one dollars and ninety-eight cents annually for each lamp that is lit in the existing light-houses, amounting to the number of one thousand nine hundred and thirty-two, per schedule hereto annexed, and a like sum for each lamp that shall be lit in light-houses that may hereafter be built, if they shall be lit an entire year, or a proportion of that sum if they shall be lit only a part of the year, during the continuance of the five years aforesaid; the said sum to be paid to the party of the second part on the first day of April in each year, or as soon thereafter as may be during the continuance of this contract.

5. The party of the second part agrees to receive the quantity of oil remaining on hand at the several light-houses on the first day of January aforesaid: Provided, the same shall not exceed an average supply of eight months, and provided it shall be of good quality, to be determined by the returns of the several superintendents to the office of the Fifth Auditor, both of summer strained oil and winter pressed oil from head-matter; and, in lieu thereof, the party of the second part engages to return and place at the several light-houses, the like quantity, quality, and kind of oil, so that there will be at each of the light-houses, at the termination of the five years when this contract will expire, the same quantity of oil as was on hand at the said light-houses on the first day of January aforesaid, without any charge, cost, or expense therefor.

6. The party of the second part further agrees to receive all the tube-glasses, wicks, buff skins, and whiting, which may remain on hand at the several light-houses on the first of January aforesaid, the quantity to be determined also by the returns of the superintendents, and to return or leave at each of the light-houses the same articles and quantity at the expiration of the contract, without demanding or receiving any compensation therefor.

7. The party of the second part shall visit and inspect the several light-houses at least once a year, and render a statement of their condition to the Fifth Auditor and acting Commissioner of the Revenue.

8. The keeper of each light-house may annually consume, for his household use, a quantity of oil not exceeding twenty gallons, out of that delivered by the party of the second part for the use of the light-houses, without any allowance or compensation being made to the said party of the second part therefor.

9. Whenever the light of the lamps of any light-house shall be suspended, a proportionate deduction for the time they may be so suspended shall be made from the sum of thirty-one dollars and ninety-eight cents to be allowed the party of the second part annually for each lamp.

10. The party of the second part shall not be liable for any losses that may happen in consequence of war between the United States of America and any other power; but he shall be answerable for all other losses, unless one or more of said light-houses be destroyed; in which
event, the party of the second part shall not be answerable for the property in said house belonging to the United States.

11. It is expressly agreed and understood, that if the party of the second part shall fail to comply with any essential condition of this contract, the right is hereby reserved by the Fifth Auditor and acting Commissioner of the Revenue to annul it at any time previous to the expiration of the five years aforesaid; in which case, the party of the second part shall be accountable for all the injuries and losses that may arise in consequence thereof.

It is hereby provided that no member of Congress shall be admitted to any share or part of this contract or agreement, or to any benefit to arise therefrom.

In witness whereof, &c.

---

Copy of Articles of Agreement, made on the eighth day of December, in the year of our Lord one thousand eight hundred and thirty-seven, between Stephen Pleasonton, Fifth Auditor of the Treasury of the United States, and acting Commissioner of the Revenue, of the one part, and Charles W. Morgan, William R. Rodman, and Edward Merrill, all of New Bedford, in the State of Massachusetts, of the other part:

This agreement witnesseth, That the said Stephen Pleasonton, for and in behalf of the United States, and the said Charles W. Morgan, William R. Rodman, and Edward Merrill, for themselves, their heirs, executors, and administrators, have mutually covenanted and agreed as follows:

1. The party of the second part shall keep all the light-houses now built in the United States, and all others that may be hereafter built and fitted up, agreeably to W inslow Lewis's patent lamps and reflectors as now used, together with the beacon lamps, supplied with a sufficient quantity of best spermaceti strained oil, for the consumption of the lamps, at their own expense, from the first day of April to the first day of December, and a sufficient quantity of best winter pressed oil, from head matter, from the first day of December to the first day of April, in each and every year, for and during the term of five years, from the first day of January, anno Domini one thousand eight hundred and thirty-eight; the lamps to be lighted at sunset, and to be extinguished at sunrise, each and every night.

2. The party of the second part shall and will, at his own cost and expense, keep in good and complete repair all the lamps, reflectors, and apparatus fitted in the light-houses aforesaid, and all the oil butts, oil heaters, clock-work, wick boxes, tube boxes, hand lanterns, cannis ters, torches, oil feeders, oil carriers, frames, diamonds, &c., for and during the term of five years aforesaid, and shall deliver over, at the expiration of the term aforesaid, all the light-houses fitted up, with all the apparatus and articles above enumerated, to the United States, in good repair: Provided, nevertheless, If the said apparatus described in the above
article be not in good repair (which shall be determined by the returns of the superintendents to the office of the Fifth Auditor) when the party of the second part takes possession of the same agreeably to the terms of this contract, said apparatus shall be put in good repair at the expense of the United States.

3. The party of the second part shall and will also, at his own proper cost and expense, supply all the tube-glasses, wicks, buff skins, and whiting, which may be necessary for the consumption of the light-houses, for and during the term of five years aforesaid.

4. The United States shall pay to the party of the second part, in full satisfaction for the performance of the stipulations by them entered into as aforesaid, at the rate of thirty-five dollars and eighty-seven and a half cents, annually, for each lamp that is lit in the existing light-houses, amounting to the number of two thousand one hundred and forty-seven, per schedule hereto annexed, and a like sum for each lamp that shall be lit in light-houses that may hereafter be built, if they shall be lit an entire year, or a proportion of that sum if they shall be lit only a part of the year, during the continuance of five years aforesaid; the said sum to be paid to the party of the second part on the first day of April in each year, or as soon thereafter as may be, during the continuance of this contract.

5. The party of the second part agrees to receive the quantity of oil remaining on hand at the several light-houses on the first day of January aforesaid: Provided, The same shall not exceed an average supply of eight months, and provided it shall be of good quality, to be determined by the returns of the several superintendents to the office of the Fifth Auditor, both of summer strained oil and winter pressed oil from head matter; and in lieu thereof, the party of the second part engages to return and place at the several light-houses the like quantity, quality, and kind of oil, so that there will be at each of the light-houses, at the termination of the five years, when this contract will expire, the same quantity of oil as was on hand at the said light-houses on the first day of January aforesaid, without any charge, cost, or expense therefor.

6. The party of the second part further agrees to receive all the tube-glasses, wicks, buff skins, and whiting, which may remain on hand at the several light-houses on the first of January aforesaid, the quantity to be determined also by the returns of the superintendents, and to return or leave at each of the light-houses the same articles and quantity at the expiration of their contract, without demanding or receiving any compensation therefor.

7. The party of the second part shall visit and inspect the several light-houses, at least once a year, and render a statement of their condition to the Fifth Auditor and acting Commissioner of the Revenue.

8. The keeper of each light-house may annually consume, for his household use, a quantity of oil, not exceeding twenty gallons, out of that delivered by the party of the second part, for the use of the light-houses, without any allowance or compensation being made to the said party of the second part therefor.

9. Whenever the light of the lamps of any light-house shall be suspended, a proportionate deduction for the time they may be so suspended
shall be made from the sum of thirty-five dollars and eighty-seven and a half cents, to be allowed the party of the second part, annually, for each lamp.

10. The party of the second part shall not be liable for any losses that may happen in consequence of war between the United States of America and any other power, but he shall be answerable for all other losses; unless one or more of said light-houses be destroyed, in which event the party of the second part shall not be answerable for the property in said house belonging to the United States.

11. It is expressly agreed and understood that if the party of the second part shall fail to comply with any essential condition of this contract, the right is hereby reserved by the Fifth Auditor and acting Commissioner of the Revenue to annul it at any time previous to the expiration of the five years aforesaid; in which case the party of the second part shall be accountable for all the injuries and losses that may arise in consequence thereof.

It is hereby provided that no member of Congress shall be admitted to any share or part of this contract or agreement, or to any benefit to arise therefrom.

In witness whereof, &c.

STEPHEN PLEASONTON,
Fifth Auditor.
CHARLES W. MORGAN.
WILLIAM R RODMAN.
EDWARD MERRILL.

Signed and sealed by the party of the first part in presence of us.

THOMAS MUSTIN.
JOSEPH THAW.

Executed by the party of the second part in presence of us.

LEMUEL WILLIAMS.
WILLIAM H. TAYLOR.

LIGHT-HOUSES—SOUTHERN COAST.

Letter from the Secretary of the Treasury, transmitting a report of Surveys of the Coast south of the Chesapeake, with the view to the establishment of Light-houses, &c.

DECEMBER 11, 1837—Referred to the Committee on Commerce.

TREASURY DEPARTMENT, DECEMBER 12, 1837.

SIR: In the House of Representatives, in Congress, on the 23d day of February, 1837, it was "Resolved, That the Secretary of the Treasury be directed to cause the necessary examinations to be made of the seacoast south of the Chesapeake bay, with regard to the location of additional light-houses, beacons, and buoys, and report the result to Congress at its next session."
In obedience to this resolve, the undersigned has the honor to report, that on the 17th of March last he issued to Napoleon L. Coste, lieutenant commanding revenue-cutter Campbell, a letter of instructions, which is annexed. This officer was selected for this duty on account of his experience in relation to the southern coast, and the Department places great confidence in the reports made by him. During the last summer and autumn, communications from that officer, on the numerous examinations made in pursuance of the aforesaid resolve, have been received, which are also transmitted.

From them it will be seen that he recommends—
1st. A new light-house at the mouth of Tampa bay.
2d. A light-boat in the northwest passage of Key West.
3d. On the coast of Florida, several new light-houses, and various other important improvements.
5th. At Charleston five beacons and three additional buoys.
6th. A small beacon light on Wilkinson's point, on the Neuse river, and also a light-house on Body island.

I am, very respectfully, your obedient servant.

LEVI WOODBURY,
Secretary of the Treasury.

Hon. J. K. Polk, Speaker of the House of Representatives.

TREASURY DEPARTMENT, March 17, 1837.

SIR: Captain Farnifold Green having been directed to repair to New Orleans, and to relieve you in your duties upon that station with the cutter Woodbury, you will, upon his arrival, return to Baltimore with the cutter Campbell. Congress having, at its late session, directed an examination of part of the seacoast, with a view to the establishment of additional light-houses, beacons, and buoys on the shores and in the waters leading to the ports of entry, I have thought that your return from New Orleans would afford a suitable occasion to institute the required examinations on that part of the coast embraced between Tampa bay and Cape Henry, Virginia. Accordingly, I have to request that you will, on the passage to Baltimore, touch at all the intermediate ports of entry, making such observations and inquiries during the voyage, and visit at the several ports, as may be useful in aiding the Department to make the required report. The result of your inquiries, together with such details as may be necessary to fully understand the reasons for any additional works of the kind referred to in the resolution, will be communicated to the Department by you on or before the 1st of November next. You will also examine and make a separate report on the condition of the several light-houses and light-boats, and upon the state of the buoys, already established, which are within the above-mentioned limits.

I am, &c.,

LEVI WOODBURY,
Secretary of the Treasury.

N. L. Coste, Esq.,
Lt. commanding revenue-cutter Campbell, New Orleans.
U. S. Revenue-Cutter Campbell,
Tampa Bay, July 5, 1887.

Sir: I have the honor to report, that the first place which presents itself to me of importance for the erection of a light-house, is at the mouth of Tampa bay, on the north point of Eggmont key. The western coast of Florida is very low, and similar in appearance, making it necessary for the mariner to have some mark by which he could take his departure; and as Eggmont is the point which all vessels endeavor to make when bound to St. Mark's, Appalacheeola, or St. Joseph's, it is my opinion, that by the erection of a light-house on the point above-mentioned, the navigation of the coast would be facilitated, and much property saved which is now annually lost by shipwreck. It is also important that I should inform you that a light-house would be a leading mark over the bar into Tampa bay, a bar capable of admitting small-class frigates, and navigable to within ten miles of its head for sloops-of-war at all times.

I am, very respectfully, your obedient servant,
NAPOLEON L. COSTE,
Lieutenant Commanding.

Hon. Levi Woodbury,
Secretary of the Treasury, Washington, City.

U. S. Revenue-Cutter Campbell,
Key West, July 15, 1887.

Sir: I have the honor to report, that I have examined the northwest passage of Key West, and would suggest the propriety of placing a light-boat on the inner part of the bar leading through that passage. All vessels passing through the Gulf stream into the Gulf of Mexico, drawing not more than ten and a half feet of water, shorten their voyages very much by availing themselves of this passage, as it puts outward-bound vessels sixty miles to windward of the Tortugas, and shortens their voyage more than one hundred miles. Those who know the passage pass through it without a pilot in good weather. Vessels bound from ports in the bay of Mexico to the northern ports cannot so readily enter this passage, because the bar is nine miles northwest from Key West, and when rainy or hazy weather occurs the town cannot be seen that distance; and there is now no object near the bar so striking as to assure the mariner that he is right. All this would be obviated by a light-vessel anchored in the best water, just within the bar.

All vessels passing this channel avoid the dangers of the Tortugas shoals and quicksands, &c., which destroy so many vessels, and occasion the loss of so much property.

The northwest bar is very short, and it is supposed that, at a moderate expense, it is susceptible of being deepened to the same number of feet as the mouth of the Mississippi and the bar of Mobile.

In times of war, such a passage would be invaluable to the safety of
our coasting trade; in times of peace, it is of countless value in shortening and rendering safe our coasting voyages.

Whilst I have the honor to remain,

Very respectfully, your obedient servant,

NAPOLEON L. COSTE,

Lieutenant Commanding.

Hon. LEVI WOODBURY.

Secretary of the Treasury, Washington City.

---

U. S. REVENUE-CUTTER CAMPBELL,

St. Mary’s, (Ga.) August 9, 1837.

SIR: I have the honor to report, that I have examined that portion of the coast of Florida embracing all the Florida reef, and, from my experience and previous knowledge of that coast, I think that, instead of being a dread and terror to navigators, it may be made as safe and easy to navigation as any other portion of our coast; to accomplish which, I would suggest, in the first place, instead of the beacon now on Love Key, that a light-house be erected. 2d. That a light-house be placed on the Sombrero Key. 3d. A light-house on Indian Key. 4th. A light-house on the Musquito bank 5th. A light-house on the Basin bank, near the present site of the light-boat, or on the Triangle shoal, which is a little farther north; and the light-boat may, if deemed practicable, be removed to the northwest bar of Key West. 6th. A light-house on Soldier Key, called on all charts Key Biscayno; and the light-house on Cape Florida torn down, or left as a beacon, whichever may be considered most practicable. In recommending the above, I would wish you to understand that it would be impossible for any vessel standing in for the coast to be out of sight of all the lights, if they are looked out for. They will be at such distances that one might be seen before the other is lost sight of, in coming from any direction; and in most positions two will be seen at once. The Gulf will then be perfectly safe. At present there is but one light on the whole extent of coast from Key West to Cape Florida, and most navigators, from the changes of current, (it being impossible to make any calculation for it,) when expecting to make that light, find themselves on the rocks either north or south of it; whereas, if the lights I propose were there, no part of the coast could be approached without seeing a light to warn them of their danger and point out their course.

The passage within the reef, from Key Biscayno to Key West, is also becoming more known, and more extensively used by coasting vessels bound outwards from the northern ports. All coasting vessels of a light draught of water might advantageously use this passage, instead of crossing the Bahama banks. To aid in this advantage, as I have before stated, the light-house on Cape Florida, commonly called Key Bas Key, should be removed to Key Biscayno, commonly called Soldier Key,
five or seven miles southeastwardly from its present location, and nearer
the reef. This would aid all vessels in taking the inner channel, and
be seen also by heavy vessels at a greater distance outside and in the
Gulf.

I am fully confident that the buildings can be erected on the sites I
refer to, and, when built, will of course be of less expense than light-
vessels. The foundation is a rock, and a sufficient quantity of material
is at hand to form the basement of the buildings. The Sombrero Key is
at all times dry. The Musquito bank has from one to three feet of water
on it, and is midway from the shore to the main reef; it is very extensive,
and protected by the main reef from heavy seas. The Triangle shoal
is much the same, but dry at low water, and distant about one mile and
a half from the present site of the light-boat, in a northeast direction;
and the Basin bank is more extensive than either of the others, with
from one to three feet of water on it, and well protected by other reefs
from the sea. Key Biscayno contains about ten acres; it is a solid
rock, with some little soil and growth of mangrove, as high as any land
on the coast. I would call your particular attention to the fact, that
on all the charts extant the light-house is marked down on what is called
Soldier Key, and not on the point of land called Cape Florida.

A buoy is required off the main channel of Key West, in place of one
gone adrift.

Remaining, very respectfully, your obedient servant,

NAPOLEON L. COSTE,
Lieutenant Commanding revenue-cutter Campbell.

Hon. LEVI WOODBURY,
Secretary of the Treasury, Washington City.

U. S. REVENUE-CUTTER CAMPBELL, August 27, 1837.

SIR: I have the honor to report, having examined the entrance to St.
Simon's sound. I would suggest the erection of the light-house on St.
Simon's island, instead of the north end of Jekyll, as mentioned in the
appropriation. By erecting it on St. Simon's island in a westnorthwest
direction from the present light-house, they will then range for crossing
the bar.

The bar is very narrow, and, from its great distance from the land, it
is difficult to find without ranges. To render it perfectly safe for large
ships, buoys will also be required, at least four.

A light-house off the north end of Jekyll island can be of no service.

I have the honor to be, very respectfully,

Your obedient servant,
NAPOLEON L. COSTE,
Lieutenant Commanding U. S. Revenue Service.

Hon. LEVI WOODBURY,
Secretary of the Treasury, Washington City.
U. S. Revenue-Cutter Campbell, 
Charleston, October 1, 1837.

SIR: I have the honor to report, that I have made the necessary examinations and inquiries for the purpose of ascertaining the best positions for erecting the five beacons already appropriated for by Congress at its last session. In all my inquiries, those to whom I have applied (being pilots and masters of coasters) have concurred with me in the positions which are shown on the plan accompanying this report. Three additional buoys are also recommended. To enable the Department fully to understand the plan, I have drawn lines up the channels, and colored the proposed lights in red. The first beacon I suggest to be placed in range with the light-house for crossing the Ship bar; the second and third to range in crossing Overall channel; fourth and fifth to range for running up channel to Sullivan's island. One additional buoy on the south breaker of Ship bar; one on a shoal extending itself from the Swash reef, on the north side of Overall bar; one large can or boat buoy on the lower end of Middle-ground, in Rebellion roads.

As far as my experience and the examinations I have now made enable me to judge, I feel assured, in making the above suggestions, that I have selected the most suitable positions. You will perceive, by referring to the plan, that one light might be so placed as to guide in over the Ship and Overall bars, by building it a little higher than the other. If that method were adopted, four beacon-lights would serve for the entrances of the bars.

I am, very respectfully, your obedient servant, 
NAPOLEON L. COSTE, 
Lieutenant Commanding.

Hon. Levi Woodbury, 
Secretary of the Treasury, Washington City.

---

U. S. Revenue-Cutter Campbell, October 26, 1837.

SIR: I have the honor to inform you that I visited Wilkinson's point, on the Neuse river, and would suggest the erection of a small beacon-light on it. I visited it at the request of the Collector at Ocracoke. It is his opinion, as well as that of all masters of vessels and pilots, that a light is much needed. It is a turning point, with a dangerous shoal making from it.

Body's island is the next place, and one of great importance. More vessels are lost there than on any other part of our coast. It is the easternmost point of land on the coast of North Carolina, forming, in fact, a cape. It is my opinion, that, by the erection of a light-house on it, much property would be saved, and the navigation of the coast facilitated.

I am, very respectfully, your obedient servant, 
NAPOLEON L. COSTE, 
Lieutenant Commanding.

Hon. Levi Woodbury, 
Secretary of the Treasury.
LIGHT-HOUSE PAPERS.

LIGHT-HOUSE SYSTEM.

Letter from the Secretary of the Navy, transmitting a report of the Navy Commissioners of their proceedings under the act of March 3, 1837, making appropriations for Light-houses, &c.

December 22, 1837.—Referred to the Committee on Commerce.

NAVY DEPARTMENT, December 21, 1837.

I have the honor to transmit to the House of Representatives the enclosed report of the Commissioners of the Navy Board of the 15th inst., made through this Department.

I have the honor to be, with great respect,

Your obedient humble servant,

M. DICKERSON.

To the Honorable James K. Polk,
Speaker of the House of Representatives.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

In compliance with the requisitions of the 2d section of the act of Congress, making appropriations for light-houses, beacons, &c., approved 3d March, 1837, the Board of Navy Commissioners have the honor to transmit the following statement of their proceedings under this act.

As it was impossible for the board to devote much time to personal examination, without a neglect of their ordinary duties, they were obliged to cause the examinations to be made by others. With few exceptions, the persons selected for the performance of this duty were officers of the Navy, who, at the request of the board, were placed under their orders by the head of the Navy Department.

Although the board would have preferred that the examinations and reports should have been made, in each case, by at least three persons, the number of objects embraced in the law, the great extent of coast upon which they were spread, and the importance of an early decision upon them, would not permit such an arrangement.

A copy of the instructions of the board to the different officers, together with copies of circulars addressed to the different commanders of revenue cutters and officers of the customs, by the Secretary of the Treasury, requiring them to give aid in making the examinations, are herewith enclosed.

The different persons who made the examinations were selected with reference to their convenient situation for attending to this duty, and from a confidence in their judgment, and in their ability to execute it in a proper manner; and the board, after carefully examining their reports, have, in most instances, been influenced by their opinions in forming the decisions which they were required to make.

This course was the more readily adopted, as the decision of the board, which might be adverse to the expenditures for any object, would only

3 L H P
operate as a suspension, until the further pleasure of Congress should be expressed in relation to it.

* * * * * * *

In addition to these reports, which are specially required by the act of Congress, the board transmit a copy of a general report made by Lieut. G. J. Pendergrast, in relation to Lakes Erie, Huron, and Michigan. In the examination of these lakes, for the objects authorized, he availed himself of his opportunity for collecting information, which, with the opinions he formed upon that information, it is believed, may be useful in determining upon any future measures for giving increased security to the great and rapidly increasing interests upon those lakes, and their extensive and fertile shores.

The board also transmit a copy of a report from Captain Joseph Smith, in relation to the entrance to Passamaquoddy bay, which furnishes interesting information in relation to the existing difficulties in the navigation of that place.

It will be perceived by the reports of the different officers, and the papers which accompany them, that in many cases great diversity of opinion existed as to the best position, or the most appropriate character, of the works proposed; and, in some instances, whether any additional measures at all were necessary for the safety of commerce, or for the public interests. From some of the reports there appears reason to apprehend that, in some cases, the works already established are susceptible of improvement, either in their character or in their position.

When the great importance of the light-house system is considered, in relation to the safety of human life, and of vast amounts of property; to the facilities and rapidity of communication, which it gives between different parts of our extensive Atlantic and lake coasts, and to the cost of establishing and supporting it, the board would respectfully suggest, whether some additional measures may not be desirable for obtaining the necessary information, to secure the greatest public advantages from the expenditures which may be hereafter authorized for these purposes.

All which is respectfully submitted.

I. CHAUNCEY.

To the Honorable the Speaker
of the House of Representatives.

A.

NAVY COMMISSIONERS' OFFICE, April 8, 1837.

SIR: The Secretary of the Navy, by the order herewith enclosed, having placed you under the orders of the Board of Navy Commissioners, to enable them the better to carry into effect the duties imposed upon them by the second section of the act of Congress making appropriation for light-houses, &c., approved on the 3d March, 1837, a copy of which section is annexed, the board have decided to assign to you the collection of information and the examination of the positions in the —— which are designated in the act aforesaid, for the erection of
certain works therein mentioned, a list of which you will find hereto annexed.

In the performance of this duty, you will endeavor to obtain, in writing, from such persons as may, from practical knowledge and general intelligence, be deemed most competent to form correct and impartial opinions:

1. Whether the safety of navigation requires any additional facilities; and, if so, whether the particular kind of object proposed by the act will be best adapted for the purpose; and, if not, what other would be better, with reasons therefor; together with an estimate of the cost of such substitute.

2. If no additional facility is deemed necessary for the safety of the navigation, or the navigation itself should be deemed too inconsiderable to justify the proposed expense of erection, attendance, and support; or if there should be reason to fear that the object would probably be mistaken for others of a similar kind, and thus expose vessels to danger; or if, from any cause, it should be deemed inexpedient to erect any of the proposed works, then the reasons to be fully stated for the opinions expressed, with any facts or other information which may enable the board to arrive at correct conclusions.

3. Whether the particular position, which may have been selected or designated by the act, is the best for the purposes proposed; or, if any, and, if any, what, change of position is desirable to secure greater advantages from the work, and the reasons therefor; and where no position has been named, then what particular position is preferable, and the probable price at which the same can be purchased.

It is desirable that the information for each of the specified objects of appropriation should be made and kept separately and distinct from each other, for more convenient reference and use, and in all cases the reasons should be stated for the opinions which may be expressed.

You will also proceed to examine, personally, each of the positions proposed, so as to forward, with the information you may derive from others, your own opinion, with your reasons, upon all the points above specified; so that, if it should be decided not to recommend the erection of any of the proposed works, the reports in relation to them may accompany the required report of the commissioners, for Congress.

As it is deemed important that a decision should be made as early as possible, you will proceed to the performance of this duty with the least possible delay, and will transmit your reports, and the information obtained upon any and each of the objects, whenever completed, without waiting to complete the others.

The Secretary of the Treasury has given directions to the different collectors, and the commanders of revenue vessels, to give you all the aid in their power in performing these duties, as you will perceive by the circulars, copies of which are annexed. If it should be necessary to hire boats or other conveyances for purposes of examinations, you will make application for the same, when practicable, to some collector or other revenue officer, that he may procure them. If this cannot be done, you will obtain them on the most favorable terms, and approve bills for the same. Such expenses, and every other, excepting your travelling expenses, must be made out against the object for which they
are incurred, and be forwarded to the Fifth Auditor of the Treasury for settlement. Accounts for your own travelling expenses must be forwarded, as usual, to the Fourth Auditor.

You will be careful, however, to incur no expense but such as shall be indispensable to the proper performance of the duties herein assigned to you, in addition to the assistance which can be obtained from the officers of the revenue vessels and of the customs, to whom the circulars of the Secretary of the Treasury are addressed.

I am, very respectfully, your obedient servant,

JOHN RODGERS.

To ——— ———.

Copy of the 2d Section of the Act of Congress for light-houses, &c., for 1837; approved 3d of March, 1837.

SEC. 2. And be it further enacted, That before any of the improvements aforesaid are commenced, the Board of Navy Commissioners shall cause an examination to be made, for the purpose of ascertaining whether the safety of navigation requires any additional facilities; and, if so, what is most suitable for each place needing such additional facilities; and thereupon to report their opinion in regard to all such places, as speedily as may be, to the Secretary of the Treasury, who shall proceed with the works so recommended. But if the said board, after causing such examination to be made, shall be of opinion that any of said improvements are not needed to facilitate the navigation, or that the navigation is so inconsiderable as not to justify the proposed works, or that the same are inexpedient from any cause, no further proceedings shall be had; and their opinions, with the facts, shall be reported to Congress.

Circular from the Secretary of the Treasury to the officers in command of revenue cutters.

TREASURY DEPARTMENT, March 17, 1837.

SIR: Congress having directed certain examinations in regard to light-houses, to be instituted by the Board of Navy Commissioners, I have to request that you will afford all the facilities to the officers who may be detailed from the naval service on that duty, which may be in your power. You will take them on board the revenue cutter under your command, and convey them to and from such points, within the limits of your cruising station, as they may wish to visit in the discharge of the duty referred to; and will also convey them to the revenue cutter on the adjoining station, in the further prosecution of the examination, whenever desired.

I am, very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

To the officers in command of revenue cutters: Crawford, Eastport; Morris, Portland; Madison, Portsmouth; Hamilton, Boston; McLane,
Circular from the Secretary of the Treasury to the officers of the customs having charge of revenue boats.

TREASURY DEPARTMENT, March 20, 1837.

By the 2d section of the act of the 3d of March, 1837, making appropriations for building light-houses, light-boats, beacons, &c., the Board of Navy Commissioners are directed to cause certain examinations to be made for the purpose of ascertaining whether the safety of navigation requires any additional facilities, &c., and to report their opinion thereupon to the Secretary of the Treasury.

I have, therefore to request, that upon application being made to you by any officer of the Navy, or other persons acting under the direction of the Navy Commissioners, to be allowed the use of the revenue boat and hands attached to your port, that they may be placed at his disposal.

Any other aid or facilities which may be in your power to render towards the promotion of the examination before stated, to the persons engaged in the same, the Department has to request may be afforded.

LEVI WOODBURY,
Secretary of the Treasury.

This addressed to—
Captain Joseph Smith, Boston.
Com. W. M. Crane, Portsmouth, New Hampshire.
Com. John Downes, Boston.
Com'r J. Percival, Boston.
Com'r F. H. Gregory, New Haven.
Captains Sloat, Kearney, and Perry, New York.
Com'r Paulding, New York.
Sailing-master F. Mallaby, Sackett's Harbor.
Lieutenant G. J. Pendergrast, Erie, Pennsylvania.
Com'r E. A. F. Vallette, Philadelphia.
Captain A. Claxton, Baltimore.
Captain B. Kennon, Old Church, Virginia.
Captain Chas. Skinner, Norfolk, Virginia.
Lieutenants Petigrus and Ingraham, Charleston, South Carolina.
Com. A. J. Dallas, Pensacola.
Captain L. Rousseau, New Orleans.
MARK ISLAND.
Navy Commissioners' Office, December 15, 1837.

The report upon this item, by Captain Smith, induced the board to recommend a suspension of expenditures until the subject could again receive the attention of Congress.

The number of lights already built in that quarter would, certainly, seem to render the chances of mistaking one for the other very probable; and such mistakes might produce much injury.

His recommendation for providing beacons, &c., for other places, are submitted for the information of Congress.

I. CHAUNCEY.

PORTLAND, May 1, 1837.

Dear Sir: As a difference of opinion may exist among those whom you may think proper to consult, respecting the necessity for additional facilities for further promoting the safety of commerce in this section, permit me, before I hazard an opinion on a subject of such vital importance, to inform you that I have coasted along this shore for the space of twenty-five years, at all seasons; and have frequently been placed in trying situations for the want of proper marks to distinguish such points as were absolutely necessary to be known, in order to shape my course in safety. A light-house on Mark island, in my opinion, would rather serve to embarrass than assist the navigation; indeed, the passage into Harpswell sound is so extremely difficult that no one unacquainted with it should attempt it at any time. The most experienced pilots reluctantly enter it. Also, the navigation of this sound is very inconsiderable, frequented only by a few fishermen. Instead of this light, therefore, I would beg leave to suggest the propriety of erecting a monument on Half-way rock. This rock lies directly in the passage of vessels bound either east or west, about midway between Portland and Seguin lights. There are several rocks which could be taken for this, and should a vessel take either of the other rocks for this in thick weather, and shape a course for a harbor as from this, it would inevitably be fatal. I would inform you that all vessels seeking for a harbor in this vicinity generally make the Half-way rock, and shape their course accordingly.

The following are the bearings of the light-houses, &c., from the rocks, viz: Seguin light, east half north, about fifteen miles distant; Drunker's ledge, north northeast, distant two and a half miles; Mark island, north by east, half east, distant four miles; light-houses on Cape Elizabeth, southwest by west, three-fourths west, distant ten miles; Bulwark shoal, (southern part,) southwest by west, distant six miles; Portland light-house, west half south, eleven miles.

I would also recommend placing buoys on the following dangerous ledges, viz: one on Mark Island ledge, bearing south southeast from Mark island, distant about seven miles; and two on Bulwark ledge, bearing from Portland light-house south southeast, distant about seven miles; this ledge was formerly called Cod ledge; the Bulwark, an English
seventy-four, grounded on it during the late war, and from this circumstance it derived the present name. This is the outer shoal between Cape Elizabeth and Seguin. I therefore deem it important that the position of this shoal should be made as conspicuous as possible, as vessels falling in with these two buoys would make sure of their position in thick weather, and would shape their course for a harbor of safety.

Also, one on Taylor’s reef, bearing about southeast by south from Cape Elizabeth, distant about one mile and a half.

Also, one on the outer part of Broad Cove rock, bearing north from Cape Elizabeth, about two miles distant; all of which would, in my opinion, cost not exceeding four thousand dollars.

And, furthermore, no doubt you will perceive the necessity of having some distinguishing mark for each of these buoys, either by different color, shape, or otherwise.

I have the honor to be, &c.,
GREEN WALDEN,
First Lieut., U. S. R. S.

To Captain JOSEPH SMITH.

UNITED STATES REVENUE CUTTER MORRIS,
Portland, April 22, 1837.

SIR: In reply to interrogatory 1st, on the opposite side of this paper, I would observe that the safety of navigation, in my opinion, requires additional facilities in this immediate vicinity, but not of that kind proposed by the act of March 3, 1837. Instead of having a light-house on Mark island, I would strongly recommend placing buoys on the following dangerous ledges and reefs, viz.: one on Drunker’s ledge, bearing from Mark island south by east, distance two miles, and generally visible at low water; one on Mark island, bearing south southeast from Mark island, distance one mile; one on Bulwark ledge, bearing from Cape Elizabeth light-house east half north, distance six miles—on this ledge, the Bulwark, an English seventy-four, grounded during the late war; and from which circumstance the ledge derived its name; one on Taylor’s reef, bearing southeast by south from Cape Elizabeth, distance one mile and a half; one on Trundy’s outer reef, distance one mile from the shore, and nearly midway between Cape Elizabeth and Portland light-house; one on Hussey’s reef, bearing east northeast from Portland light-house, distance four miles. My reasons for recommending buoys instead of a light-house will be found in answer to your second interrogatory. The probable expense of placing said buoys, as above suggested, would amount to about three thousand dollars.

In answer to interrogatory 2d, I would state that a light-house on Mark island would, very probably, prove the destruction of many valuable lives and vessels, by mistaking it for some other light in the same vicinity, Portland light, for instance. If a person were to make a light on Mark island, and mistaking it for Portland light, he would, of course, endeavor to get its bearings on, agreeably to the directions for sailing into the harbor of Portland, viz.: from west northwest to north north-
west, and run for it, which would carry him on to one or both of the two reefs first named in my reply to interrogatory 1st. Besides, it appears to me that the navigation is too inconsiderable to justify the proposed expense. If I am rightly informed, and I believe I am, there are not over twenty-five fishing boats and coasters that are in the habit of going in and out of the passage, which, by the way, is not over fifteen rods wide, and very intricate in every respect. None but those who are perfectly acquainted ever have or ever will attempt it. I am persuaded, from eight months' experience on this coast, during which I have been constantly cruising from one port to another, that no more lights are required in the vicinity of Portland. We have, at present, when the weather is anywise clear, five lights in sight at the same time, viz: one on Wood island, two on Cape Elizabeth, one on Portland head, and one on Seguin island.

Interrogatory 3d is, I believe, fully answered, in my reply to interrogatories 1st and 2d.

I have the honor to be, &c.,

EZEKIEL JONES,
Captain of U. S. Revenue Cutter.

To Captain JOSEPH SMITH.

P. S. There is already a stone monument on Mark island, that can be seen in the daytime fully ten miles; its height is from 80 to 100 feet above the surface of the sea.

E. J.

EASTPORT, MAINE, May 19, 1837.

SIR: Since forwarding reports to you in regard to a light-house upon Mark island, a fog-bell on Seguin island, and monuments on Buck's, Odom's, and Old Point ledges, I have received the enclosed communications from Captain S. H. Howes, commander of the steamer Bangor, a man of considerable experience in the navigation of the waters where those objects lie, as well as a seaman of general intelligence; his statements are made in accordance with the views of the pilot of the said steamer, an old and experienced packet master.

Although Captain Howes had expressed to me, previously, a strong desire to have a light-house erected on Mark island, I perceive by his communication in writing, that he has changed his opinion as to the location, and now recommends as more eligible another site. I, however, perceive no good reason for changing the opinion expressed in my report on that subject.

In relation to the buoys as necessary to be placed on ledges, as recommended by Captain Howes, I can only say that some of them are highly important, I know; but the locations of others I have not examined, and cannot, therefore, speak from personal observation.

The passage through the "Muscle ridges," so called, near Whitehead light-house is dangerous, and deserves the attention of the Government. Very many masters and owners of vessels have called my attention to these dangerous rocks and shoals as requiring buoys, as well as to the
fog-bell on Whitehead, which, from some cause, has ceased to sound its warning notes to the mariner.

Some idea of the importance of affording to navigation every possible facility at that point may be inferred from the fact that more than four hundred vessels sometimes pass that channel in a day.

I have again to apologize for thus travelling out of the strict path of the duty assigned me, in attending to a subject not specifically mentioned in my instructions, and have taken the liberty to do so for the information of your board, and to subserve the interests of navigation generally.

The revenue-cutter Crawford, upon which I relied to aid me in the further prosecution of my duty, is now absent on a cruise, which will occasion a delay of some days; I regret this, as it has been my wish to prosecute the business required of me with the utmost despatch.

Respectfully,

JOSEPH SMITH,

Captain, U. S. Navy.

Commodore John Rodgers,

President of the Board of Navy Commissioners.

UNITED STATES REVENUE-CUTTER MORRIS,

Vinalhaven, Fox Islands, May 9, 1837.

SIR: I have the honor to forward you from Portland, on the 1st instant, a report of my examination of "York Nubble," as a site for a light-house.

In the further execution of my instructions, I proceeded in this cutter, Captain Jones, from Portland, on the 2d instant, to Mark island, in Casco bay, where a light-house is also proposed to be erected. This island lies at the entrance to Harpswell sound, off the small town of Harpswell, and in the vicinity of Freeport and North Yarmouth.

Upon this island there has been a substantial stone monument erected, to distinguish this from various other islands in the vicinity, as well as for a mark to enter the sound.

In regard to the necessity of a light-house upon this island, in addition to the monument, I have received, I herewith transmit the written opinions of Captain Ezekiel Jones and Green Walden, the captain and first lieutenant of this cutter; the latter is considered one of the best pilots on this coast, and upon his judgment and long experience great reliance may safely be placed. I have consulted various other persons of experience, but I have only received the written statements of the two officers just mentioned.

It seems to me that the reasons given for the opinions expressed by them are conclusive upon this matter.

The fact that five lights are discernible at the same time in approaching this part of the coast of Maine, should be kept in view when considering the propriety of placing other lights in their vicinity. Owing to several dangerous shoals and sunken ledges in the neighborhood of Mark island, it is hazardous to approach in thick weather, and in the
night at all times, except by those well acquainted; and in clear weather a light is unnecessary.

Vessels running in from sea might easily mistake a light there for Portland light, when the weather is hazy, and if so, the compass course for Portland light would lead the mariner among many dangerous reefs and ledges, which, with the wind blowing on shore, would almost certainly prove fatal. After mature deliberation, therefore, I accord most fully in the written opinions expressed in the communications enclosed, and report adversely to the erection of a light-house upon Mark island.

I have come to the foregoing conclusion from the best examination I have been able to make upon the spot, and from a general view of the coast, the dangers and harbors contiguous to it, and from the best light I could obtain upon the subject.

I feel confident that experienced mariners will generally concur with me. There are, however, those who urge the erection of the light-house in question, who honestly believe it would be of public utility; and among them is Captain Howes, commander of the steamer "Bangor," who passes this point, either inside or outside, almost daily; he has promised to furnish me with the written opinions of himself and pilot in favor of said light-house. I have delayed this report a few days, in hopes to have received it to forward it with this. I will transmit it when received.

It may be that those differing from me are right in their suppositions upon this question; men of judgment and experience often differ in opinion, and I would by no means have my own set up as a criterion, or pass for more than it is worth.

Having made my decision on the expediency of a light-house upon "Mark island," I now proceed to enumerate the additions and improvements I conceive to be necessary to the safety of navigation, and by far of more general utility than the light-house referred to as a substitute.

"Half-way rock" is situated nearly equally distant from Portland and Seguin lights. It is a landmark much used by coasters and others, and when made there is no difficulty in shaping a course for a safe harbor. It is surrounded by deep water, and in the common passage of coasting vessels. In hazy or foggy weather, other rocks are sometimes mistaken for this, and when that is the case disaster is the probable consequence.

Portland light bears from it west half south, ten miles distant; Mark island north by east half east, four miles; Drunken ledges north north-east, two and a half miles; Cape Elizabeth southwest by west by three-fours west, nine to ten miles; Bulwark shoal (south part) southwest by west, six miles distant. Upon this rock I respectfully recommend the erection of a stone monument, and the cost of it I estimate at three thousand dollars.

Upon a dangerous sunken reef called "Bulwark ledge," lying about seven miles east southeast of Portland light-house, east by north half north, seven miles from Cape Elizabeth, I recommend placing two buoys, to distinguish it from "Alden's ledge," which lies about five miles southwest of it, and has now one buoy upon it. The cost of these two buoys I estimate at five hundred dollars.

Also upon a dangerous reef called "Drummer's ledge," which gener-
ally shows itself at low water, lying south of Mark island two and a half miles. I respectfully recommend placing a buoy with some mark, by color or otherwise, to distinguish it from other monuments of a similar kind, the cost of which I estimate at two hundred and fifty dollars.

Also upon "Mark Island ledge," a dangerous reef lying about one mile south southeast from Mark island, I recommend placing a buoy, and estimate the cost at two hundred and fifty dollars.

Also upon "Taylor's reef," bearing southeast by south from Cape Elizabeth, one and a half miles distant, I respectfully recommend placing a buoy, and estimate the expense at two hundred and fifty dollars.

Also upon the outer part of "Broad Cove rock," bearing north from Cape Elizabeth, about two miles distant, I most respectfully recommend placing a buoy, and the cost I estimate at two hundred and fifty dollars.

I am not sure that the estimates I have made for the works just named are very precisely accurate, but I believe I am warranted in saying that the whole can be completed for the sum appropriated for the light-house upon Mark island.

Respectfully, &c.,

JOSEPH SMITH,
Captain, U. S. N.

Com. John Rodgers,
President of the Board of Navy Commissioners.

MOUNT DESERT ISLAND.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Captain Smith having recommended a change of position for the light-house proposed in this item, and sustained his opinion with reasons which seem entitled to weight, the board have recommended a suspension of the expenditure, that the subject may receive from Congress such further consideration as they may deem proper.

I. CHAUNCEY.

CHARLESTOWN, MASSACHUSETTS, June 6, 1837.

Sir: I have the honor to present the result of my examination under the appropriation "for a light-house to be erected on a proper site on Mount Desert island, at the entrance of Frenchman's bay."

After a minute examination, I have been irresistibly led to the conclusion that no point upon that island is proper for this purpose. Were the navigation of Frenchman's bay, which would be benefitted by a light at that place, amounting to 2,245 tons only, of sufficient importance to warrant the expense of erecting and maintaining it, Egg rock, Yellow island, or the Porcupines, would be more conspicuous sites, and better adapted as guides into that bay, than Mount Desert island. I think, however, that the present light upon Baker's island affords all the facility
required by vessels bound into Frenchman's bay, for making a safe harbor; and were a light established upon either of the points named, it might be mistaken for the former, or for that on Mount Desert rock. If the appropriation for a light-house could be changed for Mount Desert harbor, I do not hesitate to state, as my opinion, that such diversion would be of great public utility, Mount Desert being the highest in the first land made in approaching this part of the coast. The harbor being safe and commodious for ships of the largest class, and having many indentations for smaller vessels and fishing craft, is a sort of general rendezvous for coasting vessels and fishermen in bad weather. I am informed that over 600 sail have been counted in these inlets at one time. It is a focal point for all vessels passing through the in-shore thoroughfares. In each of the channels to this harbor there are ledges directly in the way, to avoid which, by day and by night, some conspicuous monument should be provided. A light, placed at some point which will answer that end, appears to me of considerable moment. Various and contrary opinions are entertained as to the proper location. After a careful examination of them, and viewing the different points named, I am of opinion that Bear island is, upon the whole, the best site. A low light placed upon the western part of this island, at an expense of $3,000, would afford a safe guide to vessels coming into the main and all the smaller harbors in that vicinity. The bearings of the ledges, and the courses to be run by the proposed light to avoid them, are correctly stated in the communication of Henry S. Jones, Esq., which is herewith presented, and to which I beg leave particularly to refer you. The communications from Messrs. Brewer, Thomas, and Shaw, refer to locations in Frenchman's bay, where, as I have already stated, a light is not needed. The statement of Mr. Spurling, recommending Spurling's point, on Cranberry island, I have duly considered. After viewing the place designated by him, I cannot concur in the opinion expressed by him; nor do the officers of the cutter, to whom he refers in his communication, as the commander expressly stated to me.

I obtained from the deputy collector at Southwest harbor, Mount Desert, a list of the vessels owned in that district, and registered in that office. The number is 85, and the aggregate tonnage is 6,384. It will be observed by the letter of Mr. Moore, herewith enclosed, that he demands $500 for Bear island, containing about ten acres, which, I am informed, cost him but a few months ago $101.17.

Buos, costing about $50 each, are much needed on the following ledges: one at Southwest harbor, and two upon a large and dangerous reef in the middle of Bass harbor. A pyramid or other monument is also required upon "Bunker's ledge," which is situated outside of Bear island; the expense of which would be about $1,000. The above are all the facilities which, in my opinion, are required in this vicinity, and complete the examinations embraced in your instructions to me of the 8th ultimo.

It will have been perceived by your board, that in the different statements which have been made in regard to the location of light-houses and other works, which have been the subject of my examination, much diversity of opinion exists among gentlemen of probity and respecta-
bility. Such is not an uncommon occurrence upon questions of this nature, involving various and opposing interests.

In the suggestions I have had the honor to make, and the opinions I have expressed in the several reports presented to you, it has been my aim, after a careful examination of the evidence before me, to place before your board an impartial view of each case, with reference to the general interests of navigation. In doing this, I may, in some cases, have transcended the duties contemplated by my instructions. If I have done so, it has been from a desire to afford all the light upon the whole subject which the various observations I have made, and the information which has been communicated to me, have placed within my reach; and I trust the interests of commerce will not be prejudiced thereby. My reports, I am aware, have been in very many particulars imperfect, and I require great indulgence at your hands. They have been necessarily drawn in great haste, having regard mainly to correctness in point of fact.

During the time I have been employed on this duty, the weather has generally been unpropitious, and the information which I early sought from various sources, touching that duty, has been slow to come in, which have occasioned some delay. Under all the circumstances attending the performance of this duty, I have endeavored so to discharge it as to meet your approbation.

I am, very respectfully,

JOS. SMITH,
Captain, U. S. Navy.

Com. ISAAC CHAUNCEY,
President of the Board of Navy Commissioners.

RAM ISLAND.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The views presented in the report of Captain Smith induced the board to recommend a suspension of expenditures for this item of the appropriation. The number of lights already built in view of Ram island seems to corroborate the opinion expressed by Captain Smith, that some of them may be either unnecessary or capable of being placed on more important positions; it is therefore respectfully referred for the consideration of Congress, whether a special or more general examination shall be had, to determine upon this and other doubtful points.

I, CHAUNCEY.

PORTLAND, MAINE, June 2, 1837.

SIR: I arrived here last evening, and have now the honor to report the result of my examination of "Ram island, as a site for the erection of a light-house.

This island is situated off the mouth of Damariscotta river, and bears from Burnt Island light (Townsend) N. W. 4 miles distance, Cuckolds
W. by S. 1/4 S. 4 miles, Squirrel island N. W. 2 1/2 miles, Damariscove island S. W. by S. 1/4 S. 3 miles, Seguin light S. W. by W. 1/4 W. 10 miles. It is near a group of other islands, which form a sound through which all vessels pass going in or coming out of Townsend harbor. This is well known as one of the most important harbors upon the whole coast. It is easy of ingress and egress, large, safe in gales from any point of the compass, deep, with good anchorage in any part of it. It is a harbor which all vessels bound east or west, when met by head winds or unfavorable weather, endeavor to make, being a sort of rendezvous for coasters; and more than 300 sail have been seen anchored there at one time. The question, then, is, what works will give to navigation the greatest facilities, and where shall they be placed?

Any one much acquainted with nautical affairs, sailing into Townsend harbor from the west, and from it through the eastern passage, will be struck with the advantages a light at the entrance of the eastern passage would give; and there is no point, in my opinion, so well adapted to this end as Ram island. But when the fact is stated, that from that island there are in view four light-houses, and within the compass of twelve or fifteen miles seven lights, viz: Seguin, Pond island, Hendrick's head, Burnt island, Pemaquid, Franklin island, and Monhegan, one of two conclusions seems to me inevitable: either that some of these lights are not judiciously located, or that no more are required in that vicinity. I am strongly inclined to the former conclusion. The light on Hendrick's head, for instance, might be mistaken for Townsend light; indeed, this has been the case during its short duration, and the consequences have been most disastrous to property and life. Were this light removed further out, this evil would be remedied. I am inclined to believe that the erection of a light-house upon Ram island, and fixing a more conspicuous location for Hendrick's Head light, that would answer as a guide for both Sheepscot river and Townsend, would render that at Townsend useless, and that at Pemaquid of but little service; as the former would be an unerring guide to Damariscotta river and to Townsend harbor, and would also be very beneficial to avoid the Cuckolds, two dangerous rocks almost directly in the passage; but, as persons whose opinions have weight are opposed to the discontinuance of any existing light, I would not recommend such a measure without a more minute and particular examination being had than I have been able to make; but, while the present lights are supported, it would not, I think, be judicious to establish another upon "Ram island."

It cannot, it seems to me, escape the observation of any one who will take a glance at the chart of this section of the coast, that some of the lights have been placed with a view to local rather than the general interest.

In support of the expediency of a light upon "Ram island," I have the honor to forward herewith the written opinions of William M. Reed, Esq., a gentleman of great experience and well acquainted with the waters in this region, and of several gentlemen who are shipowners, masters of vessels, and pilots, whose judgment is to be relied upon, as I am sure their statements are, although they may not accord with some of the views I have expressed in this report.
A buoy upon Bantam ledge, I consider a necessary and indispensable work. This reef lies outside and to the westward of Ram island, and south southwest, two and a half miles distant, from Damariscove Island harbor. It is hidden from view except at low water, and its situation very dangerous, and many vessels have been wrecked upon it, and there is no beacon or other guide by which it may be shunned. I was myself near being cast away upon it many years ago, having struck it in the daytime at high water.

I respectfully suggest the propriety of causing a buoy to be placed upon this ledge; and the cost would not exceed two hundred dollars.

A monument upon the eastern Cuckold, also, would be of advantage; this is one of two low rocks, as has heretofore been mentioned, lying between Seguin and Townsend harbor, which are so shaded by the high land upon the main, as to be discovered with difficulty by vessels passing the sound. A substantial monument, to answer the purposes designed, would not cost more than fifteen hundred dollars. If, however, the location of Hendrick’s Head light shall, at any future time be changed, it will probably be near to the place named for the monument, and, in that case, would supersede the necessity of the latter.

Respectfully, &c.,

JOS. SMITH,

Captain, United States Navy.

To the President of the
Board of Navy Commissioners.

SPoon ISLAND.

NAVY COMMISSIONERS’ Office, December 15, 1837.

The reasons assigned by Captain Smith, in his report, against the erection of a light-house at this place, were deemed sufficient by the board to concur with him in opinion, and more especially as it had been determined to sanction the lights authorized to be placed on Saddleback ledge, which was stated to be but eight miles from it.

I. CHAUNCEY.

CHARLESTOWN, MASSACHUSETTS, June 5, 1837.

Sir: Having waited to receive further information regarding the expediency of erecting a “light-house on Spoon island, in Penobscot bay,” I now ask leave to report that this island lies about eight miles eastward of Saddleback ledge,” and about two and a half miles from the east head of Island au Sante.

A light on this island, in my opinion, is not required. It would be beneficial only to the few vessels which pass in by Spoon, Marshall, and Horn islands, to Blue Hill and Ellsworth. Indeed, it may be doubted whether even to such vessels a light there would be of much service, as
the passage is intricate, having in it many ledges and sunken rocks; and it would hardly be prudent to pass by this light alone, with no other object as a guide.

If a light be placed on "Saddleback ledge," (and I beg leave to refer you, most respectfully, to the opinions I have expressed in a former report in favor of that ledge as a site for a light-house,) it might often be impossible to distinguish, even by experienced pilots, the one of these lights from the other, and great embarrassments would necessarily ensue. I am, therefore, of opinion, that a light upon Spoon island should not be established.

A light upon the aforesaid ledge would be of great and general advantage, while one on Spoon island would be beneficial to but few.

Most of the vessels coasting westward from Mount Desert, Union river, Blue Hill, and places in that vicinity, pass through the in-shore thoroughfares, except when some of them may be obstructed by ice, in which case they go from Deer Island passage out by "Saddleback ledge." In either case, a light on said ledge would be of general benefit, while one on Spoon island would be of use but to the few who might occasionally use it.

I spent a part of two days of fine weather about Spoon island, and, during that time, I did not discern a sail of any description pass in or out the Spoon Island channel.

I herewith enclose communications from several gentlemen, supposed to be competent to judge, but who express contrary opinions regarding the expediency of establishing (and the benefits to be derived if established) a light upon said island. These opinions are honestly expressed and entertained; and, from the whole, you may, I trust, be enabled to come to a correct conclusion.

Most respectfully, &c.,

JOSEPH SMITH,
Captain, United States Navy.

Commodore Isaac Chauncey, &c.

CHARLESTOWN, MASSACHUSETTS, June 7, 1837.

SIR: By this morning's mail I received two communications from Ellsworth, Maine, regarding a light-house on Spoon island. The opinion already expressed to you by me on that work remains unchanged. I do not consider the navigation of Ellsworth, Taunton, and Blue Hill, of sufficient magnitude to warrant the expense of a light.

Be pleased to place the enclosed on file with the papers before transmitted upon the same subject.

I am, &c.,

JOSEPH SMITH,
Captain, United States Navy.

Commodore Isaac Chauncey, &c.
HALF-TIDE LEDGE.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Captain Smith having, in his report upon the objects embraced in this item of the appropriation, advised some material changes in the character of the objects proposed, the board deemed it expedient that the expenditure should be suspended until Congress should take further action in the case.

I. CHAUNCEY.

CHARLESTOWN, MASSACHUSETTS, June 5, 1837.

SIR: After making my observations at “Pleasant river,” the appropriation “for a beacon-light on Half-tide ledge, and two buoys, about a mile and a half from Sullivan, in the county of Hancock,” next demanded my attention.

“Half-tide ledge,” is a reef about thirty feet across, covered at half-tide, showing about six feet at low water, and lying directly in the way of vessels bound into Sullivan harbor.

My opinion is, that no light is required upon this “ledge.” Some mark or monument is undoubtedly necessary, by which it may be shunned. The best work for this purpose would be a substantial stone beacon, the expense of which would be about $1,200, and I think a simple buoy costing about $75 would answer every purpose.

“Hatch’s ledge” lies nearly in channel way at “Salt-water falls,” near Sullivan village. The ebb tide, which is very strong, sets directly upon this rock.

I was there at low water, but was unable to make a satisfactory examination, the top of the ledge not being dry, which is sometimes the case at low water. The water is bold around it, and very quick; its size, as nearly as I could judge, is about forty by thirty feet at top, and it is nearly level. A buoy upon this ledge would be of very little service; the work required, if any, is a substantial stone pier or abutment, to break and shear the current, and withstand any shock a vessel might give it by coming in contact. This would be expensive, and I would not presume to make an estimate of the cost of such a work from the superficial examination I was able to make. Should it be thought that the navigation accommodated by it would warrant the expense of its construction, the ledge, no doubt, would be first surveyed by an experienced and scientific engineer.

A “ledge” off Crabtree’s point, about four miles below Sullivan harbor, lies nearly midway of the main channel, and is within six feet of the surface at low water. A spar buoy, costing about $150, would be beneficial, and, in my opinion, is necessary upon this ledge.

All the communications I have obtained, having a bearing upon the before-described works, are one from Edward S. Jarvis, Esq., collector.
of the customs at Frenchman's bay, and one from George Hindman, Esq., which are herewith transmitted.

Respectfully,

JOSEPH SMITH,

Captain, United States Navy.

Commodore ISAAC CHAUNCEY,

President Board of Navy Commissioners.

---

YORK NUBBLE.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The board have recommended that no measures be taken for erecting the light-house authorized at this place, in consequence of the reasons assigned by Captain Smith in his report.

His recommendation of other works, as substitutes for the light-house, is submitted for the information of Congress.

I. CHAUNCEY.

---

UNITED STATES REVENUE-CUTTER MORRIS,

Portland, Maine, May 1, 1837.

SIR: In answer to circulars alluded to above, I received communications from Nathaniel Baker and others, residing at and about the harbor of York, from Samuel Lunt, Esq., from Captain Coyle, of the steam-packet Portland, and Green Walden, a man of much experience as a pilot upon this coast, and now first lieutenant of this cutter.

These communications are herewith forwarded for your consideration, and form a part of this report.

It will be seen by them that, with the exception of Captain Coyle, who is now for the first time in command of a boat, and who does not profess to be much acquainted with the coast, they all express opinions adverse to the erection of a light-house upon "York Nubble."

The water in every direction from this point is bold, and there are three lights in view therefrom, furnishing a safe and easy guide to the mariner in approaching to or departing from the coast in any direction; indeed, an additional light here would obviously tend to embarrass rather than aid navigation generally upon the coast.

It is alleged by some that a light upon "York Nubble" would facilitate navigation, particularly in the winter season, with the wind blowing off shore, when coasting vessels wish to hug the land. These advantages are not perceptible to me, excepting, perhaps, to the few fishing and coasting vessels belonging to Cape Nedrick and Wills harbors, and steamboats, since an off-shore wind here generally brings fair weather, when the landmarks are plainly discernible, and the Nubble, one of the most prominent, can be seen; I am informed, six miles at night.

The principal, and indeed the only object of a light at this place, per-
ceived by me, is to guide coasting vessels through an in-shore passage, between a dangerous shoal called "York ledge" and Stone's rock, near the main land. The ledge lies about three miles southeast from the main land, and about two miles from said rock, and between them there is a clear passage of deep water, of about two miles in width. But when the fact is stated that this passage is not generally used by coasters or other vessels, it may well be doubted whether the dangers and embarrassments to which the proposed light would subject the mariner, by leading him too near the coast, where, with the wind from the eastward, he could not at all times "haul off," nor make by its guide any accessible harbor, would be counterbalanced by the comparatively small benefits to be derived from it. The grand in-shore thoroughfare of vessels traversing this coast is on a compass course of SW. by W., and NE. by E., passing inside of Boon island and outside of York ledge.

Having thus stated my opinion against the expediency of a light-house upon "York Nubble," with the reasons for that opinion, I now most respectfully suggest for your consideration, the propriety of the erection of a monument or beacon upon "York ledge," as a substitute.

The melancholy instances of shipwreck and loss of life upon this dangerous shoal should prompt the Government to provide the best possible remedy therefor. Nothing has suggested itself to my mind, after examining this ledge as carefully as I was able, as so effectual and proper for this purpose as a monument or beacon, of suitable dimensions and materials, erected thereon.

This would, in my view, be of most importance; the cost would be trifling, and the advantages comparatively very great. I landed upon this ledge at low water, and also took the soundings in various directions around it. The water deepens boldly, but generally, regularly; at common tides the highest points of the ledge at low water are about four feet above the level of the sea. At high water, when the sea is smooth, this dangerous reef is hidden from view. At low tide, the part above water extends from sixty to seventy yards from NE. to SW., and about fifty yards from NW. to SE. My means of forming a correct estimate of the cost of a work of the kind suggested, are now very limited. It would not, in my opinion, exceed twenty thousand dollars; and should it exceed that sum much, its value and importance would make the expenditure both just and economical.

It will be observed, from the communications of Mr. Baker and others, and of Mr. Lunt, that reasons are presented for the erection of a light-house in York harbor. These reasons are not without their weight; this harbor, as represented, is a blind one to the stranger, but when entered is safe and commodious; and a light-house upon the inner extremity of "Stage neck" would render the entrance to it both easy and safe. Vessels can carry in twelve feet at low water; the common rise of the tide is nine feet, and the current is three knots' strong, often compelling vessels to move when lying in the deepest water.

The expense of a harbor light at this place would be trifling, probably not exceeding two thousand dollars; and dwelling houses are so near that the erection of a dwelling house for the keeper would not be required. Faithful and honest keepers could be employed, I think, to
take care of the light for one hundred and fifty dollars per annum, so that the whole annual expense would not exceed two hundred dollars.

I am not certain that remarks of this nature come within the purview of my instructions, inasmuch as the appropriation for "York Nubble" could not be diverted to this object; but I have taken the liberty to make them for the information of your board.

I have the honor to be, very respectfully, your obedient servant,

JOSEPH SMITH,
Captain, United States Navy.

To Com. John Rodgers,
President of the Board of Navy Commissioners.

WING'S NECK.

NAVY COMMISSIONERS' Office, December 15, 1837.

From the report of Commodore Creighton and Captain Turner, the board were of opinion that the extent of navigation or commerce at this place would not justify the expense of the works proposed.

I. CHAUNCEY.

[Extract.]

NEW BEDFORD, MASSACHUSETTS, May 1, 1837.

Gentlemen: After much difficulty, we at last heard of a point or neck of land at the head of Buzzard's, called, as named in class No. 6, "Wing's neck;" and if this be the Wing's neck for which Congress has made an appropriation of $5,000 to erect a light-house, we are decidedly of opinion that the commerce of all the places about the neck is wholly unworthy the expenditure of so large a sum of money; and, agreeably to your instructions, we offer our reasons: 1st. Bird's Island light, being only four miles from Wing's neck, is, we believe, all-sufficient for the safety and facilities of navigation in this part of the bay. 2d. The whole trade to and from the inlets and harbors this light is contemplated to assist consists chiefly of wood shallops; and, lastly, from all the information we can collect, we are forced to the conclusion that the settlement and commerce about Wing's neck are too inconsiderable, and the population too sparse, to require the object of the appropriation. Indeed, we are not satisfied that we have visited the right place, it being said that a point of land in Boston bay is known under the same denomination; at any rate, we recommend at least a suspension of the work.

Respectfully,

J. ORD CREIGHTON,
Daniel Turner.

To the Navy Commissioners, Washington.
PAPOOSE SQUAW POINT.

The reports of Commodore Creighton and Captain Turner, as well as the memorials and certificates of others which were forwarded by those gentlemen, all seemed to refer rather to which of two positions was best for a light-house, than whether the light-house itself was required.

When on their way to examine the eastern navy yards, the board had an opportunity of making some personal observations, and to consult with the masters and pilots of some of the steamboats which navigate Narraganset bay; and from these observations and conversations the board were led to doubt whether any additional light was wanted in this bay; and, if any was required, that neither Papoose Squaw point nor Hog island presented equal advantages with Sandy point, on the island of Prudence. With these impressions, the board have recommended a suspension of expenditures until the further decision of Congress be made.

I. CHAUNCEY.

[Extract.]

NEW BEDFORD, MASSACHUSETTS, May 1, 1837.

GENTLEMEN: A light-house near Bristol is doubtless necessary for the safety and facilities of navigation in and out of that harbor, and the site is well chosen, although, in our opinion, Hog island would, on many accounts, be preferable; for the commissioners will perceive, that by the chart of Narraganset bay, a line drawn from the Dumplings to Hog island avoids every danger, and passes through the boldest water. The chief objection to placing a light on this island is the extensive flat that surrounds it, stretching southerly a half mile. To erect a building on the outer edge of the flat, would consequently be attended with very heavy expense, and to place one on the island itself would, we think, be to defeat the object aimed at; and therefore recommend Papoose Squaw point as the most suitable for a light-house.

JOHN ORD CREIGHTON.

DANIEL TURNER.

To the NAVY COMMISSIONERS.

NEWPORT, (R. I.,) May 4, 1837.

SIR: Since the communication we had the honor to make to the Board of Navy Commissioners forwarded from New Bedford, we have received the enclosed papers, the signers of whom are known to be highly respectable and experienced men, and whose opinions are entitled to consideration. If, therefore, the flat extending southerly from Hog Island is not objected to by those so well acquainted with the shoal, we must then confess the objections made to this location for a light-house are greatly diminished.

Respectfully,

JOHN ORD CREIGHTON.

DANIEL TURNER.

To Commodore John Rodgers
EXECUTION ROCK, LONG ISLAND SOUND.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Commander Gregory, to whom the examination of this place was assigned, having recommended that a light-boat be used for this position, and the board, concurring with him in opinion that a light of some kind is very desirable there, recommended that the light-boat be prepared, if, in the opinion of the Secretary of the Treasury, the terms of the act would admit of such a construction. The Secretary having decided that this was not authorized, and that a larger amount would be required for a suitable boat than had been appropriated, as appears by the letter from the Fifth Auditor, herein enclosed, the subject has been suspended for the further action of Congress.

I. CHAUNCEY.

NEW HAVEN, May 11, 1837.

SIR: In obedience to your order, I have visited the Execution rocks, off Sand's point. The easternmost part of the reef lies about N. NW. by compass from the light-house on Sand's point, and leaves a good channel of one mile in breadth between it and the shore. The reef is composed of a number of large rocks, over which the tides rise from three to five feet, leaving them bare at low water. To the westward the shoal makes out extensively, with shallow water, rocks, and hard ground; gales from the northeastward, blowing directly down the sound, occasion a very heavy sea, which breaks upon the shoal with great violence, more particularly when opposed to the tide, and the shores adjacent bear evidence of their powerful effects.

The erection of a light-house in such a situation would necessarily require a foundation of extraordinary strength, and should be of considerable extent, to give it sufficient stability, and afford accommodation for a keeper. My own opinion, founded upon observation and information from others, is that the appropriation of $5,000 is inadequate to the accomplishment of this object, and that it will require at least an expenditure of $20,000 to construct a pier and light in an efficient and durable manner. Governed by your instructions, I have used every means in my power to obtain full information on this subject, by application to those of the most experience in the navigation of the sound, but have received none in writing, except from Captain Benjamin Beecher, of this place, who has been engaged in it upwards of forty years; his opinions are entitled to much consideration. Others, of much experience, with whom I have conversed, concur in the opinions expressed by Captain Beecher, that a light is necessary on the Execution rocks, and recommend the expenditure of the appropriation in placing a floating-light upon the south side, to be in some way easily distinguished from the light on Sand's point, with the addition of a bell to be used in thick or foggy weather. It is apparent that such a convenience and safeguard to the navigation is much required. In the
summer season it is not unusual for a hundred sail to pass in a day, and at all times the number is very considerable. From the best information I can procure, the appropriation will be sufficient to furnish a light-vessel for this purpose. I enclose you Captain Beecher's letter. I have delayed making this report some time, in expectation of having other communications on the subject.

I have the honor to be, &c.,

FRANCIS H. GREGORY,
Commander.

To Commodore John Rodgers,
President of the Navy Board.

TREASURY DEPARTMENT,
Fifth Auditor's Office, November 2, 1837.

SIR: I had the honor this morning to receive your letter of yesterday's date.

It is true, as you allege, that the law does not specify whether the light on Execution rocks should be placed upon a house or a boat; but I think the intention of the law to place it upon a house is manifest, from the facts that revolving lights are never placed upon light-boats; and, indeed, it would be altogether impracticable; and double lights are often placed in light-houses; that is to say, one set of lamps above another, several feet apart, by way of distinguishing them from others in their neighborhood.

Whatever may have been the intention of the law, however, it will not be in our power to build a light-boat with the appropriation of $5,000, as it will require double that sum to build a boat for that situation.

Respectfully, &c.,

S. PLEASONTON,
Fifth Auditor and Acting Commissioner of Revenue.

To Commodore CHARLES MORRIS.

NAVY COMMISSIONERS' OFFICE, November 1, 1837.

SIR: The Commissioners of the Navy have received your letter of the 31st ultimo, and beg leave to call your attention to the fact that the law does not provide for a light-house or a light-boat on Execution rocks, but a "revolving or double light," without specifying either a house or a boat on which to erect it. Is it not therefore discretionary to make use of either?

Respectfully, &c.,

C. MORRIS.

STEPHEN PLEASONTON, Esq.,
Fifth Auditor of the Treasury.
BIG SANDY CREEK.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The reasons assigned by Master Mallaby against the erection of a light-house at this place, induced the board to recommend that no expense be incurred until otherwise directed by Congress.

I. CHAUNCEY.

SACKETT'S HARBOR, May 12, 1837.

GENTLEMEN: Enclosed are the opinions of several experienced gentlemen in relation to the proposed light-house at Big Sandy creek, in the county of Jefferson and State of New York.

Having carefully inspected the different positions pointed out in your order of 8th April, as well as such places adjacent as would be fully embraced in your general instructions, I have now the honor to communicate my views on the subject.

1st. In my two former reports having expressed an opinion favorable to the construction of light-houses on Stony point and Salmon river, I must consider any other "facilities" not only inexpedient, but calculated to defeat the object for which they were intended.

"Big Sandy creek" is without an available harbor for other than craft of the smallest description, having from two to four and a half feet water on the bar, varying by the operation of external causes, and the bar itself frequently changing its position, while the country around has so many outlets for the exportation of its productions, both to the northward and southward, there being five harbors within a distance of fifty miles, that it would not justify the proposed expense of erection, attendance, and support.

2d. It is subject to another serious objection, the distances from the head of the lake to Big Sandy creek and Stony point are nearly equal; the general course of the lake is east and west, while the bearing between these two places is about south southeast and north northwest, so that vessels approaching these points from the western extremity might, by bad steering, heave of sea, or slight deviation of compass, be thrown suddenly on the light at Big Sandy creek, and thus become embayed with the sound from the westward, and be unable to effect a passage around Stony point without having an accessible harbor at the same place.

3d. The lake is at times subject to local fogs, and the construction of two light-houses so near each other, (the distance being only ten or twelve miles,) and with such peculiarity of location, would tend greatly to embarrass the navigator should he unfortunately mistake the light at Sandy creek for the one at Stony point.

4th. There are no improvements in the vicinity of this harbor. The general face of the country round the mouth of the creek is sterile and unpromising, with an extensive marsh reaching to the point selected for
a landing, about two miles from the lake, approachable by a narrow and
tortuous passage.

Having, to the best of my ability, discharged the duties you were
pleased to assign to me,

I have the honor to be, &c.

FRANCIS MALLABY,
Master, U. S. Navy.

The Hon. the Navy Commissioners, Washington.

----------

VAN BUREN HARBOUR, NEW YORK.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The reasons assigned by Lieutenant Pendergrast induced the board
to concur with him in opinion that the light proposed for this place was
not required at this time, and they reported to the Secretary of the
Treasury accordingly.

I. CHAUNCEY.

----------

ERIE, PENNSYLVANIA, August 15, 1837.

SIR: In obedience to my instructions from the Navy Board, I have
examined Van Buren harbor with a view of ascertaining whether it was
expedient to erect a beacon-light there, and, after having made diligent
inquiry of many lake navigators, have the honor to report:

1. As to whether the safety of navigation requires any additional
facilities at that place.

I am clearly of opinion that it does not; and would beg leave to re-
mark that the harbor of Dunkirk, with its lights, is only five miles dis-
tant on one side, and Portland harbor, with its lights, seven miles on the
other.

The United States are now making a harbor at Cattaraugus creek,
and I presume, as a matter of course, there will be a light built there.
Should that be the case, and should there be lights placed at Silver
creek and Van Buren, there will be no less than five lights, viz: Catta-
raugus, Silver creek, Dunkirk, Van Buren harbor, and Portland, on a
line of coast not exceeding twenty-four miles. It must be obvious to all
that the navigators of the lakes cannot desire such a multiplicity of
lights.

2. As to whether the place is of sufficient importance to justify the
expense of a beacon.

The town of Van Buren is very small, containing only one hundred
and fifty inhabitants, and I am inclined to think its proximity to Dunkirk
and Portland harbors will prevent it from ever becoming a place of much
consequence.

Van Buren possesses some small advantages that might be available
in forming an artificial harbor, and, were it not so very near Dunkirk,
it would be thought worthy of improvement.
3. As to whether it might be mistaken for other lights, and thus expose vessels to danger.
   If made a common light, it would often be mistaken for others, unless colored or revolving shades should be used.

4. As to whether any change of position is desirable to secure greater advantages from the work.
   I know of no place near Van Buren harbor where a light is required. Could the appropriation be applied towards the erection of a beacon on the west point of the harbor of Mackinack, it would be of great service to navigation.

The accompanying circular, marked A, was addressed to many persons of experience and intelligence, and I herewith send their answers, marked B, C, D, E, F, G, and H. It will be perceived that great diversity of opinion prevails.

All of which I have the honor of submitting to the board.

I am, very respectfully, your obedient servant,

G. J. PENDERGRAST,
   Lieutenant, United States Navy.

To the President of the
Board of Navy Commissioners, Washington.

ABSECUIM INLET.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The reasons assigned by Captain Vallêtte, in his report upon this place, were deemed sufficient by the board to justify them in concurring with him in opinion that a light-house is not required here for the safety of navigation.

I. CHAUNCEY.

PHILADELPHIA, June 16, 1837.

GENTLEMEN: Herewith I enclose to you letters from persons in answer to others which I had written them on the subject of a light-house proposed to be erected "near Absecon inlet, on the seacoast," and have the honor to submit the following report of the examination which I made at the designated point:

The island of Absecon is about forty miles distant from Cape May, ten miles long and two miles wide, running parallel to the coast, its southern end forming one side of Great Egg Harbor inlet, and northern end the inlet of Absecon. Between the island and the main is an extensive sound, more than seven miles wide, full of flats or sand banks, which render the navigation extremely intricate even to small boats. The mouth of the inlet has a bar extending entirely across it, many parts of it being left bare at half tide, with two channels, having only five or six feet of water in them at high tide, and which have frequently shifted;
the point of the island forming this inlet extends out much farther to the eastward than any other part of the coast betwixt Cape May and Barnegat, and making out from this point is a sand spit of two miles in extent, and half a mile east of it there is a sand bank, upon which, in gales, the sea breaks, the extremity of which being about four miles from the beach; northeast from this point of the island lies the Brigantine shoal, distant five miles, and upon some parts of it the sea breaks in the most moderate weather; ten miles to the southward and westward of this inlet is the entrance to Great Egg harbor, and forty miles northeastward is Barnegat. I mention the relative position of these places to show that a light placed near Absecum inlet cannot benefit either of them, and I think it cannot be useful to the navigation of Absecum inlet, as it is too shoal and intricate to be attempted in the night by vessels of the smallest class. It is alleged that numerous vessels have been wrecked near this inlet, and upon the Brigantine shoal; that vessels running along the coast are frequently brought up by the shoals in the night in consequence of the uniformity of the soundings in the approach to them, five and six fathoms being carried within half a cable's length of them. I can hardly suppose, however, that the numerous wrecks which are said to have taken place here were owing to the absence of a light from this point. From 15 to 20 fathoms water will place vessels running along this shore at a safe and convenient distance, and I imagine that many of the losses met with here have been owing to stress of weather or neglect of soundings. I, therefore, cannot concur in opinion with Messrs. Canfield and Pinney that a light-house at the inlet of Absecum is necessary for the safety of navigation.

Respectfully, &c.,

E. A. F. VALLETTE.

To the Board of Navy Commissioners.

LOVE POINT, MARYLAND.

NAVY COMMISSIONERS' Office, December 15, 1837.

The reasons given by Captain Claxton against the erection of a light-house at this place were deemed sufficient by the board, and they reported accordingly.

I. CHAUNCEY.

BALTIMORE, May 18, 1837.

Gentlemen: A severe indisposition, of two weeks' continuance, contracted while on a tour in the bay, has disabled me, until now, from completing my report on light-houses, &c., in the Chesapeake bay. I resume the series.

"For erecting a light-house at Love point, in addition to the sums heretofore appropriated, one thousand dollars."
A light-house at Love point (north end of Kent island) is uncalled for by the exigencies of commerce. It would be totally useless for vessels passing up or down the bay, and is not necessary for the limited number of craft trading in Chester river. These vessels make the run to or from Baltimore by daylight; and if, from a failure of wind, they are benighted in the bay, the lights on the Bodkin, but nine miles from Love point, North point, and Pool's island, all of which are in sight, afford a sufficient guide and bearing to obtain a safe anchorage, either in Chester river or the Patapsco. The channel between Love point and Swan island is a mile and a half wide, and, with the Bodkin light to shape a course, the entrance is safe and certain; no loss has been sustained, no inconvenience felt. Believing this to be one of the numerous classes of appropriations obtained more with the view to local interest and patronage, than to public benefit, I consequently report adversely to the contemplated erection.

Very respectfully,

ALEXANDER CLAXTON.

Honorable Board of Navy Commissioners.

HOG ISLAND.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The reasons assigned by Captain Claxton, in support of his opinion that the interest of commerce did not require the erection of a light-house at this place, induced the board not to recommend any measures for carrying the object of the appropriation into effect.

I. CHAUNCEY.

"Hog Island. For the erection of a light-house on the south end of Hog island, on the Atlantic coast, §5,000."

CHESAPEAKE BAY, April 18, 1837.

Gentlemen: The south end of Hog island is the most proper location for a light-house, as here is found a tolerably good harbor for coasters, and the neighboring district has some commerce of its own. The entrance to this harbor is now buoyed, in consequence of former appropriations. I am of opinion that the sum appropriated is not sufficient, if the proposed light-house is to be built of brick or stone, as these materials must necessarily be transported from elsewhere.

I am also of opinion that no light-house should be erected on Hog island at all. No "additional facility to commerce" can be obtained by such structure at this point. The island is comparatively high, and wooded, and forms a marked feature on this line of seaboard. A light-house could add nothing to its immediate recognition by day, and, situated as it is, nearly equidistant from Smith's Island light-house (Cape Charles) and
Chingoteague light, (a distance of some forty-five miles,) would by night bewilder the mariner by the multiplicity of lights on the same line of course.

The shoals of Hog island extend seaward for three miles, but they are still within the line of course for craft sailing inside of the dangers of Chingoteague, and still much further within for ships passing outside of those dangers.

A light-house here cannot be made the means of enabling a vessel to enter the harbor by night, and, if it could, the place is so little frequented as to render it inexpedient to erect one. A light-vessel would be much more useful here than a light-house; but, repeating my remark, three lights on this direct line of coast, all within forty-five miles, would undoubtedly produce such confusion to the navigator as to lead to greater danger than now exists.

I therefore submit to the honorable Board of Navy Commissioners, that a light-house on Hog island is uncalled for by the wants of commerce, and ought not to be erected.

Very respectfully, &c.

ALEX. CLAXTON.

Commodore John Rodgers,
President of the Board of Navy Commissioners.

YORK RIVER SPIT.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The board did not recommend the erection of either of the objects proposed by the act for this place, in consequence of the opinions and reasons assigned by Captain Claxton in his report.

With respect to his proposition for changing the position to the head of the Middle ground, the board submit it for such consideration as Congress may deem proper.

I. CHAUNCEY.

CHESAPEAKE BAY, April 20, 1837.

“For a light-boat on York River spit, or a light-house, ten thousand dollars.”

GENTLEMEN: The appropriation for York River spit is presumed to be intended for the greater security of vessels navigating the Chesapeake bay, since neither the amount of commerce on York river, nor any known difficulty to its free passage, present themselves.

A light-house on York River spit is impracticable, and, if located on the main, useless, by reason of the winding of the coast, which would throw it entirely out of the range of vessels navigating the bay. The naming a light-boat in the same sentence conveys more useful intention, since, if a light-boat was anchored on the tail of York River spit, it
might, in certain exigencies, be serviceable; but even here it would be within the range of vessels passing up or down the bay. To cause a light-boat to be of any real utility in this neighborhood, it should be anchored on the head of the Middle ground. The ship channel is narrower here than in any other part of the Chesapeake, and pilots regard it as the most difficult point in the passage of the bay. On York River spit the soundings are gradual and safe, but on the Middle ground steep, too, and dangerous.

The want of a light-boat on the Middle ground has been long felt; but whatever advantage the location of one on York River spit might once have offered is now superseded by the numerous and leading lights in that quarter. By referring to the chart, forwarded some days since, it will be seen that this part of the bay is almost in a blaze of light establishments. Something should be left to the knowledge and judgment of the navigator, or otherwise every shoal, river, and creek must be lighted; an expense too enormous to be tolerated. Believing that a light-boat or a light-house on York River spit is uncalled for by the necessities of commerce, I hereby report adversely to the measure. With regard to a light-boat to be anchored on the head of the Middle ground, there can be no doubt of its expediency; and having maturely weighed its advantages, and advised with competent judges, who concur with me, I respectfully recommend that the appropriation for a light-boat on York River spit be diverted from that point to one at the head of the Middle ground, for which the appropriation is ample.

I have the honor to be, &c.,

ALEXANDER CLAXTON.

Honorable Board of Navy Commissioners.

——

LIGHT-HOUSE IN THE CHESAPEAKE.

Navy Commissioners’ Office, December 15, 1837.

The terms of this appropriation having, through some accidental inadvertence, omitted any particular position for the light-house, it was not referred to any of the examining officers, and no action has been taken upon it by the board; it is therefore referred for the further consideration of Congress.

I. CHAUNCEY.

——

DAYS POINT, VIRGINIA.

Navy Commissioners’ Office, December 15, 1837.

In consequence of the reasons assigned by Captain Kennon, the board concurred in his opinion that a light-house at this place would not be of sufficient benefit to justify the cost of its erection and support.

The views of Captain Kennon upon other points are respectfully submitted for such action as Congress may deem proper.

I. CHAUNCEY.
LIGHT-HOUSE PAPERS.

NORFOLK, May 9, 1837.

SIR: In compliance with my orders from your office, dated 7th of April last, I have inspected Day's point and its vicinity in search of the most eligible site for a light-house, and suitable positions for light-boats, &c., as well as for the purpose of ascertaining whether "the safety of navigation in that quarter required any additional facilities," and have the honor herewith to report the result of my observations, and to forward to you such written communications on the subject as I have been able to procure from persons who are capable, no doubt, of giving the best information on the subject. The letter marked A is from an experienced pilot; the one marked B is from the commander of a steamboat, who has been for a great many years passing up and down the river several times a week; and the other two are from two intelligent commanders of merchant ships, who are perfectly well acquainted with the river, its obstructions, and the delays experienced in ascending and descending it with ships, for the want of such facilities as have been referred to above.

From the mouth of James river to the head of its navigation there is not a light of any sort, or any buoy laid down, and yet its channel is peculiarly intricate, and the shoals and bars numerous; all vessels of any draught are, therefore, obliged to anchor at night, even with a fair wind. This inconvenience, causing such loss of time, could be effectually removed by the erection of three lights; one on Day's point, one at the Point of Shoals, and the other at Deep-water and Lyon's Creek shoals. With a light at each of those points, the heaviest ships could run in the night up to Hog island, about forty miles, and ships of lighter draught might go as high as Harrison's bar, about 80 or 90 miles from Hampton roads. This is the opinion of an experienced pilot, whom I employed to aid me, and whose letter will accompany this. The erection of a light on either of the points above named would (alone) be almost useless, as vessels, (except small ones,) on reaching it, would be obliged to anchor; and the three are situated within the distance of about fourteen miles. But if it be intended to erect one light, and only one, then I would, in that case, recommend its being placed on the Point of Shoals, as it is the most dangerous situation on James river.

A light-house on Day's point would not be useless, as it would enable heavy vessels to go that much farther (about ten miles) up James river at night; and it would be of great convenience to the travelling community, as it would to the steamboats, to shorten their run about seven miles, by passing through Mulberry Island swash, as it is called; and it would be equally beneficial to all vessels, not exceeding six feet draught; but this, I think, is the utmost good it could do, under any circumstances. A light-boat off Day's point, on the spit, would be preferable to a light-house on the shore, half a mile off, as the boat could be placed in three fathoms water, and so situated as to make a straight course up to it from Newport News point. The water, as you approach the spit, shoals gradually. The intermediate distance (I mean between Newport News point and Day's point) is plain and clear. There, there are two shoals, called Nasara shoals and the White shoals, through which the channel passes; but they are fully six miles apart, and may be passed
with safety at night, unless in thick weather. On passing Newport News point, which forms the northern entrance to James river, and is very bold, I brought it to bear SE. by E. by compass, and steered NW. by W., which course carried me by the Nasara shoals, in five fathoms water, and also by the White shoals in three and a half fathoms water, and up to the spit off Day's point, until I shoaled to three and a quarter fathoms; which clearly shows the inutility of a light there, unless it be desired to extend such facilities farther, and erect one on the two other points already named, viz: the Point of Shoals and Deep-water shoals. On the Point of Shoals, the foundation is hard enough for a light-house; it is a firm oyster bed, dry at half tide, and only covered at high water about two feet. It forms the apex of an angle, which is filled with shoals, extending throughout the whole of Burwell's bay from W. NW. to N. by E., and which, in many places, is dry at low water. At the other two positions, light-boats would be indispensable; that is, I mean, no other light would answer so well. A light-boat might also be made to answer all purposes at the Point of Shoals: the choice need only turn upon a question of economy. The light-house, in the long run, would be cheapest, because it would require less repairs, and but one man to keep it; an elevation sufficient to make it visible ten miles off would be sufficient.

Should it be ultimately determined not to erect additional lights on James river, three buoys would be of infinite use on the several positions named above, as well as the White shoals, which could be seen at high water; the Nasara shoals are always above water. And I also recommend buoys on the other places indicated by Captain Chapman and Mr. Hicks, the pilot, whom I can recommend as a very fit person to lay them down. He is a man of professional experience and intelligence, and great respectability, and a member of the board of examiners for pilots.

Hoping that this report will embrace all the matters deemed important by the Navy Board, and be fully satisfactory, I remain, &c.,

BEVERLY KENNON,
Captain, U. S. Navy.

To the President of the
Board of Navy Commissioners.

PEA ISLAND.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Captain Skinner has assigned such reasons for a change of position, from Pea Island to Boddy's Island, as induced the board to recommend a suspension of all expenditures until Congress shall decide upon the subject.

This recommendation, with many others of a similar kind, seems to indicate the expediency of a more general examination of the coast than has yet been made, with reference to the subject of lights, beacons, &c.

I. CHAUNCEY.
Reasons for preferring a situation on Boddy's island, five miles north of Pea island, for the location of the contemplated light-house near New inlet.

In the first place, it is designed principally to warn vessels coming from the north, who want a point of departure to shape a course to clear Hatteras, which they desire to pass as close as possible, to keep out of the Gulf stream; the beach is so low, they run on it before they are aware of danger.

Nineteen-twentieths of the vessels lost here are from the north, and come on within three miles north or south of the spot. I propose taking it as a centre. The shore on each side, for several miles, is literally covered with wrecks. I enclose a list of some lost here within ten or twelve years, all of which lie as above described.

It is farther from Hatteras, and is nearer the ocean, not being more than half a mile distant, whereas Pea island is within the sound about one and a half miles, and, in fact, is but the southwest part of the island. Vessels coming from the south make Hatteras, and steer along in the Gulf stream, which sweeps them off the land. Vessels are rarely lost south of the inlet. The steamer William Gibbons struck on Boddy's island, coming from the north, and got into New inlet by accident, where she now lies. The inlet is filling fast: at best tides there is but four feet water. The owner of Boddy's island, residing here, offers four acres, with a good title, for $100. The spot will produce vegetables for the keeper, &c., whereas, the collector at Edenton informs me the owner of Pea island (a resident of the town) would hold it at a high price, should it be selected as the location. There is no port between Hatteras and Roanoke island to draw vessels near the land, after passing Hatteras; whereas all bound north hug the shore, to keep out of the current. The land is so low it cannot be seen but at a very short distance, in clear weather. The materials for constructing the house may be transported at less expense than to Pea island, the facilities being greater. This information I derived from one who has been employed in lightening off wrecked goods into the sound. A light-house at this spot would have saved and will save many lives, and millions of property. I am of opinion a tower, sixty feet high, with a good revolving light, should be erected; revolving, because Hatteras, nearest south, is fixed. and Cape Henry, the nearest north, is also fixed.

If I have not succeeded in making it apparent that the position which I prefer is the most desirable, it is because I want the power of words. Could you visit the spot, you would at once approve the choice. I feel interested in the subject, as I conceive it, if not the most, certainly among the most, important positions for a light-house on the coast of the United States.

I have the honor to be, &c.,

 Commodore John Rodgers,
 President of the Navy Board.

CHAS. W. SKINNER.

5 LHP
Albemarle Sound, May 13, 1837.

Sir: I proceeded, as I had proposed, in a small flat-boat, for the purpose of examining Pea island and its vicinity, for the purpose of selecting the best location for the contemplated light-house near New inlet; owing to the shallowness of the water, we were compelled to anchor the flat one mile and a half from Boddy’s, and about five from Pea island, and land in a small flat canoe; here we procured horses, and rode down to Pea island, which is separated from Boddy’s by a narrow run, which we passed on horseback; from thence, after examination made, I proceeded to examine the part called Boddy’s island; here I found a spot much better situated for a light-house than Pea island, and about five miles to the north, possessing a good foundation, and entirely free from blowing sand; no hills between it and the ocean, and the ground covered by a thick and strong growth of grass. I forward the opinion of Messrs. Blount and Cox, the former collector at Washington, the latter a merchant at Edenton, (1 and 2,) as also my own opinion, with the grounds on which it is predicated. In coming off from Boddy’s island we were compelled to ride out a mile, dragging the flat canoe by her painter, the whole business attended with considerable fatigue and exposure; had it not been for the exertions of Mr. Littlejohn Pugh, keeper of the light-house at Roanoke marshes, I do not think I should have succeeded in the examination for days, if at all. He has been master of a coaster for years, is perfectly well acquainted with all parts of this coast, and so respectable in point of character and intelligence as to have been selected for years to serve in the State Legislature. He fully concurs with me in opinion as to the location, though he was strongly solicited by persons interested in the sale to recommend Pea island, should he be called on by me for an opinion. The spot chosen by myself was within 50 yards of the one where he had long been of opinion it should be erected. The agents for the underwriters of the ship Belle, a valuable New York ship recently wrecked here, selected also the same place, while attending the shipping her cargo; the gentlemen whose opinions I enclose are not so well qualified to judge as seamen; they both are of opinion on or near would answer the purpose; the position on Boddy’s deserves the preference.

Respectfully,

CHARLES W. SKINNER.

Commodore JOHN RODGERS,
President, Navy Board.

Jekyll Island, Georgia.

Navy Commissioners’ Office, December 15, 1837.

The reasons assigned in the report of Lieutenants Petigru and Ingraham for recommending that a light-house should not be built at this place seem to be conclusive, and the board fully concur in the opinions which they have expressed upon the subject.

I. CHANCEY.
Schooner Exit, Brunswick Harbor, June 10, 1837.

SIR: A light-house on Jekyll island cannot be made a mark for Brunswick bar nor for the channel, nor can we see, however great the commerce of the place may become hereafter, any useful purpose it could serve. It is not necessary to distinguish Brunswick bar, for the two lights we have mentioned cannot be mistaken for any other. As a guide to run up the river it would be very unfit; as a mark to ascertain when over the bar, by bringing it to bear SW. by S., is the opinion of one who has no practical information, for not until long after you are within the bar will any part of Jekyll island bear SW. by S.; we found when on the bar the north end of Jekyll island to bear nearly W., and the south end nearly SW. by W.; we are of opinion, therefore, there should be no light-house on Jekyll island, as it would tend to confuse and mislead.

The accompanying papers contain all the information we have been able to collect; that of the keeper of the light-house is the only one entitled to any consideration.

Respectfully, &c.,

T. PETIGRU.
D. N. INGRAHAM.

Com. John Rodgers,
President, Board of Navy Commissioners.

BRUNSWICK, GEORGIA.

Navy Commissioners' Office, December 15, 1837.

Lieutenants Petigru and Ingraham reported the navigation or commerce of Brunswick to be too inconsiderable, in their opinion, to require any additional facilities. In the absence of any information tending to discredit this opinion, formed after inquiry upon the spot, the board have concurred with it, and have reported against the expenditure of the appropriation until the further pleasure of Congress is known.

I. CHAUNCEY.

Schooner Exit, Brunswick Harbor, June 10, 1837.

SIR: After an examination, we have the honor to report that the navigation of Brunswick, in its present state, requires no additional facilities, because the navigation is too inconsiderable. During the last winter a few vessels arrived here with materials for building the town, and they are expected to return again in the fall. There are as few dangers presenting themselves in entering the harbor of Brunswick as in entering any harbor on our coast that we are acquainted with; the
channel over the bar is wide enough for vessels in, and is without, or with very little, alteration of course. Until you are past the light-house, and in safe anchorage, there are no buoys; the light-house is the only object that marks the entrance.

Should it be intended, however, to render the entrance "to the harbor of Brunswick secure and easy at all times," buoys will be required on North breaker or South breaker, on Middle ground, and on Jekyll Point spit; these are the only points the navigator has to fear. For night, a beacon-light so placed as to range with the present light and the bar; this is northwest by north half west, and southeast by east half east, or nearly so. The light-house now stands three or four hundred feet from the water, and four or more miles from the bar; a beacon-light would be too near the light-house if placed in front of it; it would, therefore, be necessary to lower the present light-house (the light is an ordinary one, and shows badly) and erect a light-house, three-quarters or half a mile to the westward, to range with the beacon and the bar. When this is done the entrance will be safe and easy at all times. The site we should select for a light-house belongs to Mr. King; he is not here; but we are told Government would find no difficulty in purchasing it. The materials for building the light-house would have a land carriage of three or four hundred feet. We can form no estimate of what the cost of building, &c., would be.

T. PETIGRU.
D. N. INGRAHAM.

Commodore John Rodgers.

LIGHT-HOUSE ON SAPELO ISLAND, GEORGIA.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

In the copy of the act which was furnished to the board from the Treasury Department, no mention was made of a light-house for this place, and consequently the attention of the examining officers was not called to the subject. As their report, however, states "that a large can buoy placed in the best water on Sapelo bar, and a frame beacon on the south end of St. Catharine's island, are all the facilities which the present state of navigation requires," the board have not recommended the erection of a light-house.

I. CHAUNCEY.

SCHOONER EXIT, AT SEA, June 15, 1837.

SIR: We have examined Sapelo bar, and have the honor to report that navigation here has no facilities.

The harbor affords good anchorage, is easy of access, and, in adverse winds or stress of weather, may be highly useful to vessels on the coast. The navigation here is confined to small vessels, employed in carrying
the produce from the plantations in the vicinity to market. We deem a large can buoy placed in the best water on the bar, and a frame beacon on the south end of St. Catharine's island, all the additional facilities the present state of navigation requires.

The bar extends out about four miles from the land; we crossed it this morning at 7 o'clock, (without pilot,) the south end of St. Catharine's, per compass, west by north, in 20 feet water. We judge the tide to have been about half ebb.

It is not in our power to furnish any information, from persons residing near here, as to what works they may deem necessary for the improvement of the harbor. We have conversed with Mr. Spalding, of Sapelo island, and Mr. McIntosh, collector of Darien. Mr. Spalding agrees with us. Mr. McIntosh referred us to the collector of Sunbury, Georgia, who has charge of this district, on whom we have not called, deeming it unnecessary.

Respectfully,

T. PETIGRU.
D. N. INGRAHAM.

Commodore JOHN RODGERS,
President of the Board of Navy Commissioners.

LIGHT-BOAT WITHIN MARTIN'S INDUSTRY.

NAVY COMMISSIONERS' OFFICE, December 15, 1887.

While the letter from Lieutenants Petigru and Ingraham expresses the opinion that a light-boat in this vicinity is required for the safety of navigation, they recommend that it be placed in a different position from that named in the act. Concurring with these gentlemen in the opinion that a light-boat was desirable if it could be advantageously and safely placed, it was recommended by the board, provided the Secretary of the Treasury should be of opinion that the terms of the law would justify the change of position proposed. The Secretary of the Treasury having decided that the proposed change is beyond his authority, the subject is referred back to Congress, that a change may be authorized if they should deem it expedient.

I. CHAUNCEY.

CHARLESTON, June 26, 1887.

SIR: Martin's Industry is a very dangerous shoal, on which vessels bound to Savannah have frequently been lost. It is separated by two channels which run through it from Port Royal entrance. The southern part is known as Gascoyne bank, and extends farthest into the sea, seven or eight miles; it drops abruptly from three to seven fathoms, the water still deepening to eight and nine fathoms, and then shoals to seven fathoms, forming what is called Tybee channel. It is in this channel
we would recommend the light-boat to be moored; the bottom is suitable, and the light here would bear, per compass, from Tybee light E. by N. half N. and W. by S. half S., sixteen or eighteen miles; and, from the trees on the north end of Hilton Head island, called Port Royal hat, N. NW. and S. SE.

It would, in our opinion, answer the object intended much better here, than if placed within "Martin's Industry;" for, if within, it must be in Port Royal channel, where the holding ground is not as good, and the boat would be equally exposed to the violence of the NE. and SE. storms, or so far within as to make a light-house on the coast an object as easily distinguished at sea. The pilots and all the shipmasters we have conversed with on the subject are of the opinion the light-boat should be without the shoal.

The light is for the benefit of vessels bound to Savannah, but will answer as a mark for Port Royal entrance, and at present the navigation of Port Royal is too inconsiderable to require any addition to this; but in Port Royal sound, where the inland navigation is represented as considerable, we are of opinion two beacon-lights are necessary: one on Bob's island, at the entrance of Scull creek; the other on St. Helena island, on the north side of Station creek. These two lights, with a pole beacon on Sand island, will render the navigation of the sound easy and safe. They will be four miles from each other W. by S. half S., and E. by N. half N., per compass. The proprietors of the land were not at home while we were there; but Mr. Turner, the collector of Beaufort, has engaged to furnish the information relative to the coast, &c., which shall be forwarded as soon as received. Keepers' houses will be required, and wood also for the keeper of Station Creek light.

We have the honor to be, &c.,

T. PETIGRU.
D. N. INGRAHAM.

Commodore John Rodgers,
President of the Board of Navy Commissioners.

TURTLE ISLAND, OHIO.

Navy Commissioners' Office, December 15, 1837.

The act appropriates eight thousand dollars for a light-house at Turtle island. By the report of Lieutenant Pendergrast, it appears that there is a light-house already in operation at this place, and, consequently, that no other is required. He supposes, from information he received there, that the intention of Congress was to make an appropriation for securing the light-house already built; but the board did not feel themselves authorized to suppose what did not appear in the act itself; and therefore merely reported against the erection of a light-house, and transmitted the report and documents of Lieutenant Pendergrast to the Secretary of the Treasury for his information.

I. CHAUNCEY.
SIR: In obedience to my instructions from the Board of Navy Commissioners, I have examined Turtle island, and have the honor to submit the following remarks:

The terms of the law would seem to infer that it was intended a lighthouse should be erected on the island, but I find there are already a very good light, keeper's house, &c., and, from all I can learn, the appropriation was intended to secure the island against the destructive washing of the lake.

With a view of ascertaining the plans of the superintendent of lighthouses in regard to this island, I addressed to him the accompanying letter, marked A, and have received in answer the letter herewith sent, marked B. It would appear from what Mr. Starkweather states to have been the course of the Treasury Department in relation to this island, that it was not considered as belonging to the range of my duties, and that orders have been issued concerning it without waiting for my report.

If this point were one of little consequence, I might be induced to take no further notice of it than to state that the Treasury Department have taken measures relating to it, but I am convinced that Turtle Island light is one of the most important lights on Lake Erie, and, therefore, feel it to be my duty to offer such suggestions as I think calculated to preserve so valuable a work.

Mr. Starkweather's letter states clearly and fully the proposed plan for securing the island, and I regret to say I do not concur in it; believing, as I do, that it will be found expensive in construction, and of an unstable character.

I have been at some pains to ascertain the best and cheapest mode of arresting the destructive washing now going forward at the island, and have no hesitation in recommending that the island (or a part of it at least) should be surrounded by crib-work, raised about ten feet above the level of the lake, and filled in with good hard stone. On the side where the washing away is most felt there should be spar-cribs run out, so as to induce a deposit.

This is thought to be the most effectual, and at the same time the cheapest plan, to prevent a sandy foundation from being washed away. Piles driven on the exposed part of the island would, it is believed, in a short time be undermined, and the whole work precipitated into the water; such, at least, has been the effect at other places.

I cannot deny that it is with extreme diffidence I have offered the above remarks, knowing, as I do, how poorly qualified I am to advise on such a subject. I have, however, drawn my information from what I conceive to be a competent source, and, therefore, trust it will be thought worthy of consideration.

All of which I have the honor of submitting.

Respectfully,

G. J. PENDERGRAST.

To the President
of the Board of Navy Commissioners.
DUNKIRK, NEW YORK, May 18, 1837.

SIR: I have been appointed by the Board of Navy Commissioners to examine certain points on Lake Erie, designated in the late act of Congress relating to light-houses, beacons, &c., and would be much obliged to you for any information in your power to give as to the plan it is proposed to pursue in securing the light-house on Turtle island against the washing of the lake. I have been at some pains to ascertain what is most likely to arrest the destruction now going on at Turtle island, and have been assured by an able and experienced engineer (T. S. Brown, Esq.) that nothing will be so effectual as the constructing of crib-work around the entire space required for the light, the cribs to be filled to the height of 8 or 10 feet above the level of the lake with hard stone. Mr. Brown assures me that stone thrown on the beach will not prevent the island from wearing away, nor does he believe that driving piles will be of much service.

Respectfully,

G. J. PENDERGRAST,
Lieutenant, U. S. Navy.

S. Starkweather, Esq.,
Collector, Cleveland.

B.

CUSTOM-HOUSE, CLEVELAND, May 20, 1837.

SIR: I have received your letter of the 18th instant, requesting information, such as might be in my power to give, as to the plan proposed to be pursued in securing the light-house on Turtle island against the destructive washing of the lake.

In reply, I have to state that much solicitude and exertion has been exercised for a few years past to secure Turtle island from being washed away by the surf of Lake Erie. At the instance of the Treasury Department, Captain Talcott, of the engineer corps, was directed, in 1834, to examine the island, and report the best plan for its protection. He did accordingly submit a plan for its protection, which, however, was entirely dissimilar to that suggested to you by T. S. Brown, Esq., and founded upon quite different principles. The plan of Captain Talcott, however, was not adopted, being in my opinion, as well as in the opinion of others well competent to judge, insufficient.

In the winter of 1835, Isaac S. Smith, Esq., superintendent of public works at Buffalo, being at Washington, conferred with the Fifth Auditor of the Treasury on the subject of the best plan; he (Mr. Smith) having often inspected the island, and noticed the action of the surf of the lake upon it. Mr Smith then submitted to the Fifth Auditor a plan, which the Auditor adopted, and which was forwarded to me, and
is now in the progress of execution; contracts having already been
made for the supply of the materials, and the work I believe commenced
on. This plan, drawn on paper, with the specifications, is now in the
hands of Captain Levi Johnson, the superintendent of the work, and
who is now on Turtle island. I am unable, therefore, to give you a
copy. It is, however, to draw a contiguous row of piles around the
island, in close contact, and to fill in behind with stone and brush for
the space of 20 feet inward; the island to be reduced in size, and the
sand from the island outside of the piles to be thrown over to the area
enclosed, and the whole to be covered with good soil, and be transported
from the main land.

In this plan Mr. Smith has full confidence, and it is earnestly to be
hoped that it will be successful.

Respectfully,

SAMUEL STARKWEATHER,
Superintendent Light-houses; Cleveland.

Lieut. G. J. PENDERGRAST,
United States Navy.

MANHATTAN, OHIO.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Lieutenant Pendergrast having reported against a beacon-light at or
near this place, and recommended the use of a floating-light as a substi-
tute, the board reported against the expenditure as proposed by the
appropriation, that the subject might receive such further attention from
Congress as they might deem proper.

I. CHAUNCEY.

ERIE, PENNSYLVANIA, August 15, 1837.

Sir: In obedience to my instructions from the Navy Board, I have
made a careful examination of Manhattan and its vicinity, with the view
of selecting a suitable site for a beacon-light; and have the honor to
report:

That I am of opinion a beacon at the town of Manhattan would be
entirely useless to the general navigation of Maumee bay and river. I
therefore directed my attention more particularly to the channel across
the bay and into the mouth of the river, but was unable to find any one
place on shore that would answer the purpose. I at first thought of
suggesting that two beacons should be built, one to be placed in the bay
and the other at the mouth of the river, but since my visit to the straits
of Mackinac, I have given that place up, and would beg leave to advise
that the light-boat stationed there should be removed to Maumee bay
so soon as her present place is supplied by the construction of a light-
house.
By moving the light-boat in the short bend which the channel makes in the bay to the westward of North cape, she will be of great service. Her position will be so well sheltered as to obviate all the difficulties experienced in her present exposed station.

The formation of ice in winter is the only objection to a light-boat. There is, however, a place of safety close at hand, and, if properly attended to, she might be kept at her position during the entire season of navigation.

I beg leave to recommend that the money appropriated for a beacon at or near Manhattan be added to the sum named for a light-house in the straits of Mackinac. The suggestion is made in consequence of my having proposed to substitute the light-boat from that place for the beacon at Manhattan.

The accompanying circular, marked A, was addressed to several persons of experience and intelligence, and I herewith send their answers marked B, C.

Captain Dobbins, of the revenue service, wrote, I am inclined to think, under an impression that a light-boat could not be obtained; otherwise, I am persuaded he would have given it the preference.

All of which I have honor of submitting to the board.

I am, very respectfully, your obedient servant,

G. J. PENDERGRAST,
Lieutenant, U. S. Navy.

To the President of the Board of Navy Commissioners.

CUNNINGHAM ISLAND.

NAVY COMMISSIONERS’ OFFICE, December 15, 1837.

The reasons assigned by Lieutenant Pendergrast against the erection of a light-house on that island were, in the opinion of the board, sufficient to justify their concurrence with them, and they reported against its erection accordingly. With regard to the change of position proposed by him, the board express no opinion, but merely submit it for consideration.

I. CHAUNCEY.

ERIE, PENNSYLVANIA, June 1, 1837.

Sir: In obedience to my instructions from the Navy Board, I have made a careful examination of Cunningham island, with the view of ascertaining whether it was expedient to erect a light-house on the south side of said island, and have the honor to report:

1st. As to whether the safety of navigation requires any additional facilities at that point.

I am clearly of the opinion that it does not, and in support of this
opinion would merely remark that Sandusky light-house is only four miles distant from the south side of Cunningham island.

2d. As to whether the commerce of the place is of sufficient importance to justify the expense of erection, attendance, and support of a light-house.

I am of opinion that it is not, and would beg leave to state that the island contains only nine families, who are mostly employed in quarrying stone and in cutting wood for steamboats. It is true the island forms an excellent lee for vessels in a northeast gale, and is visited by steamboats requiring wood, but there is not the least difficulty in finding the anchorage by paying attention to the bearings of Sandusky light and the soundings.

3d. As to whether the light might be mistaken for other lights, and thus expose vessels to danger:

I think there is great reason to fear that it would often be mistaken for Sandusky light, which, as I have before stated, is only four miles distant.

4th. As to whether any change of position is desirable to secure greater advantages from the work:

I think a very advantageous change might be made; and would beg leave to remark, that several of the most experienced navigators on this lake have called my attention to the great benefits that would result from placing a light on the South Bass or Put-in-bay island, instead of Cunningham island. On examination, I am of opinion their wishes ought to be complied with, inasmuch as it would be the means of rendering a much-frequented passage easy and safe. I am not certain that the terms of the law will allow of the appropriation on Cunningham island being applied to the adjoining island, (South Bass;) but, could such a change be made, I am satisfied both the safety and general interests of lake commerce would be greatly promoted by it.

* * * * * * * * *

Respectfully,

G. J. PENDERGRAST,
Lieutenant, United States Navy.

To the Board of Navy Commissioners, Washington.

CITY WEST, INDIANA.

NAVY COMMISSIONERS’ OFFICE, December 15, 1837.

The reasons given by Lieutenant Pendergrast against the expenditure of the appropriation for this object, as proposed by the act, induced the board to concur with him in opinion. His proposition for expending the amount for erecting a light-house at New Buffalo, is submitted for the consideration of Congress.

I. CHAUNCHEY.
ERIE, PENNSYLVANIA, August 15, 1837.

SIR: In obedience to my instructions from the Navy Board, I have examined City West, with the view of ascertaining whether it was expedient to erect a light-house there, and have the honor to report:

1st. As to whether the safety of navigation requires any additional facilities at that place.

I am of opinion that it does not; and would beg leave to remark, that, so far as I have been able to learn, there is not, at this time, either navigation or commerce of any kind connected with City West.

2d. As to whether the place is of sufficient importance to warrant the expense of a light-house?

I do not think it is; and would beg leave to observe, that there are but twenty houses and one saw-mill in the place. Fort creek, the stream on which the town is situated, is very small, averaging in depth not more than five feet, and in width fifty feet. On the bar at the mouth there is from two to three feet water. These facts satisfied me that, however important and desirable it might be, to have as many harbors as possible at the head of Lake Michigan, it would be perfectly useless to expend money on a light-house at City West, until it is ascertained whether a harbor can be made.

3d. As to whether the light might be mistaken for other lights, and thus expose vessels to danger:

Michigan City light-house is distant from City West twelve miles; of course, the two lights might be easily taken one for the other, unless one of them should be made a colored or revolving light.

4th. As to whether any change of position could be advantageously made:

I am of the opinion that a light at New Buffalo would be of service to navigation; and would respectfully suggest that the one intended for City West be placed at New Buffalo, situated at the mouth of the Galien river. This river is within the south bend of Lake Michigan, and is a stream of sufficient size to allow of its being formed into an excellent harbor, at a moderate expense.

Such being the case, the mouth of Galien can but be considered a highly important point, and should be improved by Government without delay.

The light, if placed here, ought to be colored, to distinguish it from Michigan City light.

All of which I have the honor of submitting to the board.

Respectfully,

G. J. PENDERGRAST,
Lieutenant, United States Navy.

To the President of the Navy Board.

PEARL RIVER.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The board have concurred with Captain Rousseau in his opinion that
a light-house at Pearl river does not seem to be required at this time for the interests of commerce.

I. CHAUNCEY.

NEW ORLEANS, June 23, 1887.

GENTLEMEN: I have examined both passes of Pearl river. My opinion is, that the placing of a light-house at either would be a useless expenditure of public money; almost all the trade of Pearl river is with New Orleans, and is carried through the western branch which falls into the Rigolets; the light on Rabbit island is within a few miles of it, and is all that is necessary, in my opinion, for vessels going or coming from there. The southeastern branch which falls into Lake Borgne, between Rabbit island, where there is a good light, and St. Joseph's island, where one is to be erected—from either of these it will be difficult to miss the entrance of Pearl river, and at either of the above lights a good and safe harbor can be had.

I have the honor to be, very respectfully, &c.,

L. ROUSSEAU, Captain.

The Board of Navy Commissioners.

WAGOOSHANCE, OR FOX POINT, MICHIGAN.

NAVY COMMISSIONERS' OFFICE, December 15, 1887.

The remarks of Lieutenant Pendergrast upon the navigation of the straits of Mackinac, and the importance of providing means for its safety, have induced the board to recommend a suspension of action under this item of appropriation until the decision of Congress can be obtained, whether the alteration proposed by Lieutenant Pendergrast shall be authorized. So far as the board can form an opinion from the sketch, and other information forwarded by Lieutenant Pendergrast, they consider the change of position recommended for this light-house to be judicious, and calculated to give increased safety to vessels passing through these straits.

I. CHAUNCEY.

ISLAND OF MACKINAC, July 28, 1887.

SIR: In obedience to my instructions from the Navy Board, I have examined Point Wagooshance and its vicinity, with the view of selecting a suitable site for a light-house, and have the honor to report:

That I have visited no place on the lakes where I think a good light
would be of such general benefit to commerce as on the straits of Mackinac. I have found it impossible, however, to devise any plan that would embrace all the requisites at so important a place, unless at an expense much beyond the present appropriation.

The light-boat now anchored in the straits has, from various causes, been found unsuited to the purpose for which she was designed. It has been impracticable, heretofore, to place her at her station in the spring until after the straits were entirely clear of ice; and she is compelled to leave in the fall, before the close of navigation. She appears to be too small for her exposed station, and, I am informed, pitches and rolls so violently as to render it impossible to keep her light burning in rough weather. These facts make it clear that the present light-boat ought to be discontinued, and a more permanent and certain light erected in her stead. On turning to Point Wagooshance, I found there were also many strong objections to it as a site, growing out of its remoteness from the main channel, and the circumstance of a dangerous reef projecting out from the point to the distance of nearly half a mile. I soon satisfied myself that a light on that point would prove of but little service to vessels passing through this boisterous and difficult strait.

My attention was next directed to a small detached reef lying about half-way between Point Wagooshance and the light-boat—say one mile and a half from each.

This reef is only about 50 yards wide and 200 long, running in the direction of the straits, and having from five to seven feet water upon it. Between this reef and the point there is a channel one and a half mile wide and two and a half fathoms deep.

To the northward of the reef is the light-boat channel, which is very deep, and from three to five miles wide. A light on the small reef spoken of, I am persuaded, would be placed in the most eligible position possible, and I am satisfied would be of more advantage to commerce than all the other lights on Lake Michigan taken together. I therefore beg leave to recommend that one be erected there without delay.

When the light-house in question shall have been completed, the light-boat can be very usefully employed in the Maumee bay.

To enable the board to see the relative positions of places in this vicinity, I have had prepared a chart of the straits, which, although not perfectly accurate, is yet, I believe, sufficiently so for the present purpose. The small reef lying between Wagooshance and the light-boat, marked L. H. on the chart, is the proposed site for the light-house. It will cost a large sum, compared with other works of the kind on the lakes; but its great importance, in my opinion, outweighs all other considerations. Vessels may run for this light, either going or coming, with perfect safety, until they arrive within a few rods of it, when they can take either channel, at their option.

I am informed by the collector of the port of Mackinac that 500 vessels passed the straits during the year 1836, and that many of them were literally freighted with passengers.

I offer with great diffidence the accompanying estimate, marked I. It was, however, prepared after consultation with Captain Allen, of the
army, a gentleman of much experience; and I therefore trust it will be found worthy of your consideration.

All of which I have the honor of submitting to the board.

I am, very respectfully, your obedient servant,

G. J. PENDERGRAST

Lieutenant of the U. S. Navy.

To the President of the Board
of Navy Commissioners, Washington, D. C.

JULY 8, 1837.

SIR: I think the safety of navigation requires a light-house at Wa-
gooshance. There is a sunken reef about six and a half feet under water, and distant one-half mile from the main reef. I would advise the building of a light-house at this place.

This sunken shoal is about midway from the light-boat to the main reef.

In thick weather it is very difficult calculating distances, and by placing the light at the point designated by you, there would be great danger of running upon this sunken reef, the place, in my opinion, most suitable for a light. In short, I would prefer having the floating light remain, rather than the erection of a light-house at the point designated by you.

Most respectfully, yours, &c.,

A. ALLEN.

Lieut. G. J. PENDERGRAST, United States Navy.

GREEN BAY.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

The reasons assigned by Lieutenant Pendergrast induced the board to believe that, instead of another light at the entrance to Green bay, the interests of commerce and navigation would be more promoted by placing one near the head of the bay. They have therefore advised a suspension of this expenditure of the appropriation until the further pleasure of Congress can be expressed upon the subject.

I. CHAUNCEY.

GREEN BAY, July 7, 1837.

SIR: In obedience to my instructions from the Navy Board, I have examined the entrance of Green bay, with a view to the selection of a suitable site for a light-house, and have the honor to report:

That I have found several islands lying at the entrance of the bay, on
one of the northern of which (Louse island) there is already a light-house erected.

There is, however, another passage into the bay, about twenty miles to the southward, which is used by vessels bound from Green bay up Lake Michigan, and I have been urged by some to place a light in this passage. But I have arrived at the conclusion that, although a light is much needed in this southern passage, there are still stronger reasons for erecting one at the head of Green bay, near the mouth of Fox river. I have accordingly selected a spot near the centre of Grassy island, as the most eligible place, and beg leave to recommend the erection of a light at that point without delay.

Vessels running up to the head of the bay, with the wind from the northward and eastward, are much exposed to a lee shore, and have great difficulty in finding the mouth of Fox river, or any place of shelter. These facts make it manifest that a light at the head of the bay is of great importance, and induced me to examine diligently for the most favorable location.

A vessel, by bringing a light on Grassy island to bear southwest by south, can run for it until she finds herself in two and a half fathoms water; then, by steering west by north, she will cross the channel in four fathoms, and may anchor when she comes again into two and a half fathoms: She will then be completely sheltered by Sail point from all exposure.

The channel from this anchorage to the mouth of the river is so crooked as to render it impossible for one light to serve as a direction; and navigators must, therefore, depend upon buoys to guide them through the balance of the channel.

Grassy island is rather low and wet, but I believe, however, there will not be much difficulty in securing the foundation of the tower. The island belongs to the United States.

I cannot close this communication without mentioning that the commerce and travel connected with this place are very great, and that a most lamentable degree of ignorance exists amongst most navigators in relation to the various dangers and obstructions scattered over the bay.

Whilst writing this report, I have heard that a steamboat, with five hundred passengers on board, after being in great jeopardy for thirty-six hours on a reef, has, with much difficulty, succeeded in getting off. Such accidents occur frequently, and I humbly conceive appeal strongly to the General Government for a proper survey of the bay.

All of which I have the honor of submitting to the board.

I am, respectfully, your obedient servant,

G. J. PENDERGRAST,
Lieutenant, U. S. Navy.

To the President of the
Board of Navy Commissioners, Washington, D. C.
SIR: Having been appointed by the Board of Navy Commissioners to examine and select certain sites for light-houses, beacons, &c., I have now the honor to inform you that I have finished the duties assigned me, and have forwarded to your office separate reports in relation to each of the points to which my attention was directed.

The tenor of my instructions, taken in connection with the act of Congress under which I have been employed, seemed to imply that, in making my special reports, I should keep in view some connected plan with reference both to old and new improvements. I found it, however, impossible to embrace such a plan in the reports alluded to, and therefore think it proper, at present, to offer a full and general report of all matters coming within the scope of my duties, in which I have endeavored to propose a systematic arrangement of the lights throughout the lakes, and shall avail myself of the opportunity to call the attention of Government to such other improvements as I think will be of advantage to the commerce and navigation of the lakes.

My aim will be, at present, to take a hasty review of the various towns, public works, harbors, bays, and rivers that I have visited during the last four months, in which will be comprehended almost every place of the least importance, from Buffalo, at the foot of Lake Erie, to Michigan City, including those situated on the shores of Saginaw and Green bay.

At Buffalo, there is already a good stationary light on a stone tower, at the end of the harbor pier. This is, of course, highly useful, and I believe is judiciously located and well arranged. The United States have expended, to great advantage, a considerable amount of money in forming an artificial harbor at the mouth of Buffalo creek. From the unparalleled growth of this town, and its extensive commerce, I apprehend that at no very distant period it will be found necessary, for the convenience of shipping, to construct another harbor. At this time, indeed, the limited capacity of Buffalo creek is felt to be a serious impediment to business, the harbor at times being literally choked up with vessels. No place on Lake Erie is of more importance in a commercial point of view than Buffalo, and, of course, none more deserving of the favors of the General Government.

The city of Buffalo contains about eighteen thousand inhabitants; its commerce employs about three hundred sail vessels and forty steamboats.

Cattaraugus creek is thirty miles west of Buffalo. At this place there is a harbor now being constructed by the United States. When finished, I would recommend that a beacon with a red light be placed on the pierhead. I have never landed at this place, but have understood that a tolerable harbor can be formed. At the distance of three miles west of Cattaraugus is

Silver creek.—At this place there is quite a deep natural cove, leaving about ten or twelve points of the compass exposed. My examination was not such as to warrant me in saying whether an artificial harbor could or could not be readily formed. There is quite a large and flourishing village at this place, but I was induced, from its contiguity to
Dunkirk and Cattaraugus, and the fact of no harbor works having been authorized, to report against the erection of a beacon-light at this place. At the distance of nine miles west of Silver creek is

**Dunkirk.**—At this place there is a good stationary light-house, situated on a point near the harbor, and also a beacon-light on the pier-head. It so happens that the beacon and light-house are directly in range for running a most difficult part of the channel. It was therefore deemed advisable to have both a light-house and beacon at this place. The town of Dunkirk contains about twelve hundred inhabitants. The harbor, when completed, will be very safe and convenient, and may be resorted to by vessels of the largest class. An appropriation for completing this harbor in a proper manner would be a great benefit to the navigation of the lakes. At the distance of five miles to the westward of Dunkirk is

**Van Buren harbor.**—At this place there is a point projecting out on the west side, and a reef lying to the eastward. Nothing has yet been done towards forming a harbor; and whether it be practicable to make one at a reasonable expense, I am unable to say. Van Buren harbor is only five miles from Dunkirk on one side, and seven miles from Portland harbor on the other. I therefore do not hesitate to say that a beacon at this point would be entirely useless, and might be injurious to instead of benefiting navigation. Seven miles west of this is

**Portland harbor.**—At this place there is a good stationary light. I have never landed here, but have understood that there is a pier for the protection of vessels, and that it is a place of sufficient business to warrant the keeping of a light, particularly as it is kept up by an inexhaustible supply of natural gas, from the immediate vicinity. Thirty-three miles west of this is

**Erie harbor.**—There are a light-house and beacon at this place. The beacon is on the end of the pier, and is so situated that it cannot be seen by vessels running down the lake until they are very close to it. The light-house ought, therefore, to be continued until the upper entrance into the harbor is made, when a beacon will be required at that entrance, and the light-house may be dispensed with. The harbor of Erie is the largest and best to be found on Lake Erie, being between four and five miles long and about one mile wide, affording sufficient room to accommodate any amount of shipping. The neck of land that joins Presque Isle to the main has been wearing away for some years, and, unless soon arrested, will destroy this valuable harbor. It is very desirable that a large appropriation should be made without delay, and applied towards closing the breach spoken of. It is designed to make a channel at the western end of the harbor, similar to that at the eastern extremity. At present, great inconvenience is felt for the want of such an entrance; and as the commerce of the lakes and that of the town of Erie increases, it will be much more so. Erie is the terminating point of several of the State improvements, and is rapidly progressing towards extensive commercial importance. The harbor, from its capacity and security, is much resorted to by the shipping of the lake, for shelter; and unless the island which forms it is protected from being washed away, the General Government will, in a few years, lose one of its finest harbors on the southern shores of Lake Erie. Thirty miles west of Erie is
Conneaut.—This place has a good beacon on the pier-head, and an artificial harbor; both of which are very useful to navigation. Fourteen miles west of Conneaut is

Ashtabula.—At this place there is a good artificial harbor, with a beacon on the pier. To prevent this place from being mistaken for Conneaut, the light at Ashtabula ought to be colored. Fifteen miles west of Ashtabula is

Madison dock, or Cunningham creek.—I have not landed at this place, but, from what I saw of it in passing by, and from all I could learn from the navigators of the lake, I do not hesitate to say that a light is entirely useless, and ought to be discontinued. There is at this place nothing but a simple pier running out into the lake, without the semblance of a harbor, or anything else, to make it necessary to support a light. Fifteen miles west of Madison dock is

Grand river.—At this place there is an excellent artificial harbor; a light-house and a beacon on the pier. The beacon is all that is required, and I beg leave to recommend that the light be dispensed with. It probably would be as well to place reflectors behind the beacon lamps. Thirty miles to the west of Grand river is

Cleveland.—This is a point of great commercial importance, and has already a good artificial harbor, a light-house, and beacon. A beacon is all that is necessary, and I beg leave to advise that the light-house be discontinued. It would be well to place reflectors behind the lamps, and, as a mark of distinction, there might be added a revolving shade. Twenty-eight miles west of Cleveland is

Black river.—Here there is a good artificial harbor, and a colored beacon-light on the pier-head. Nothing further is required at this point. Twenty miles west of Black river is

Huron.—At this place there is a good artificial harbor, and a common beacon on the pier. Nothing more is required. Twelve miles west of Huron is

Sandusky light-house.—This is a highly important light, in consequence of its showing the entrance to Sandusky bay, and also as serving as a director through the island passage. There was a beacon-light authorized to be placed as a guide into this harbor; and I have recommended, in my report on the subject, that it be made a red light, so as to distinguish it from Sandusky light-house, and have selected Cedar point as the site for it. Four miles north of Sandusky light-house is

Cunningham island.—A light was authorized at this place, but it was thought to be perfectly useless, and I therefore reported against its erection. I suggested to the board, in a former communication, the great advantages that would result from applying the Cunningham island appropriation to the construction of a revolving light on the south end of Put-in-bay island; and I beg leave again to urge it, as a matter of the utmost consequence to navigation. Put-in-bay island is about ten miles from Sandusky light-house, but, owing to the crookedness of the passage, the two lights would be shut in from each other. Six miles to the southward and westward of Put-in-bay is

Port Clinton.—I have not landed at this place, but, from all I have heard, am perfectly satisfied that its commerce is not sufficient to justify
the expense of a light. I therefore recommend that it be discontinued for the present. Twenty miles to the westward from Port Clinton is

Turtle Island light-house.—This light is situated at the entrance of Maumee bay, and is highly useful. It is advantageously situated for directing vessels into this important bay, and no pains or expense should be spared in securing the small island on which it stands from being destroyed by the action of the lake. Seven miles west of Turtle island is

The town of Manhattan, at the mouth of Maumee river. A beacon-light was authorized at or near Manhattan, but it was impossible to place a light so as to be of much service. I have therefore recommended that, when a light-house shall have been built in the straits of Mackinac, the light-boat from that place be stationed about half-way from Turtle island to the mouth of the Maumee river. This arrangement, with a sufficient number of large black spar buoys, will render the passage in and out of this much-frequented bay easy and safe at all times. Seven miles from Turtle Island light is

La Plaisance Bay light-house.—I have not landed at this place; but, in passing by it, was satisfied that it is a place but of little consequence compared with Turtle island, and that they might very easily be mistaken one for the other. I therefore beg leave to suggest that La Plaisance Bay light be discontinued, or that the light-house be colored in some way, so as to distinguish it from the Turtle Island light. The harbor of Monroe is only a few miles from La Plaisance bay; and when the work is completed, it will, of course, require a beacon. This beacon ought to be colored; and, I presume, will render the one at La Plaisance bay still more unnecessary. Thirty-five miles to the northward of La Plaisance bay is the

Mouth of Detroit river.—Here there was a light authorized; and, after giving the subject a close examination, I reported in favor of a revolving light, to be placed at the entrance of the American channel. This light, I have reason to believe, will prove highly serviceable as a guide to both the American and English channels into the river. The town of Gibraltar is situated at the mouth of the river, on the American shore, and bids fair to become a place of consequence. Before leaving Lake Erie, I must be permitted to call the attention of the board to two other points where lights would be of great advantage. The first is the Middle Sister island, belonging to Great Britain. It is directly in the track of vessels bound up and down the lake, and is so low as to prevent its being seen in a dark night. Of course, it becomes an object of great solicitude to the mariner; and could the British Government be prevailed upon to erect a light there, it would be considered a great benefit to navigators generally. A common white light would be all that is required. The second place where I think a light would be of service is on the Western Sister island, situated in a direct course from Put-in-bay to Maumee, and distant about fifteen miles from each. Should a light be placed on this island, it ought to be colored.

Nothing presented itself to me worthy of remark, in ascending the Detroit river, except that an accurate survey of the river is very much needed. Seven miles above the city of Detroit is
Windmill point — At this place there is a light-house authorized, and I am satisfied it will prove of advantage to vessels in crossing Lake St. Clair, which is twenty miles long, and very shallow, there not being more than four fathoms water; at its head it becomes very shoal, particularly at the mouth of St. Clair river, where extensive flats make out, on which there is but ten feet water. The channel is exceedingly crooked for three or four miles, and, in some places, very narrow. These flats are dreaded by all persons, and are regarded as the most vexatious impediment they have to encounter. Vessels have been known to be two, and even three, weeks in getting over them.

I was unable to make any examinations at this place, and therefore do not feel qualified to propose any plan for its improvement. I may be permitted to remark, however, that I think the subject deserves the immediate attention of Government, and that no expense should be spared in removing the obstruction. An enterprising merchant at Detroit has, for some time past, been at the expense of placing buoys on the flats for his own convenience. These are, however, of a temporary character; and I beg leave to recommend that our Government should take the matter in hand, and place buoys there that can be seen at night. It might also be as well to plant warping buoys along the most difficult part of the channel, so as to enable vessels to pass over with a scant wind. The river St. Clair, after leaving the shoal water near its mouth, is a bold and easily navigated stream until within two miles of Lake Huron, where the rapids commence, and continue to the head of the river. The current, however, does not exceed five or six miles. Sail vessels have to wait for a strong fair wind, or employ a steamboat. Occasionally, small vessels are tracked out. At the foot of Lake Huron there is a fine light-house very judiciously located. After ascending Lake Huron seventy-five miles, is

Point aux Barques.—This is the southern point at the entrance of Saginaw bay; and I beg leave to recommend that a light be placed on this point. A light-house at this place would be of great service not only to vessels bound to Saginaw, but to those navigating Lake Huron. A vessel getting out of her course, and falling into Saginaw bay, has nothing to warn her of her danger. If a harbor can be formed near the Point aux Barques, its importance to the navigation of Lake Huron would justify almost any expenditure in its construction. As the trade of Saginaw increases, there will be a light required on Charity island, or some point near it, on the north side of the bay. Forty miles from Charity island is the mouth of

Saginaw river — This is a very large stream, but has a bar at its mouth, on which there is only six feet water. An effort should certainly be made to remove this obstruction. I consider a light very necessary here, and reported accordingly. About sixty miles to the northward of Point aux Barques is

Thunder Bay Island light.—This light is very well situated, and of great service to the navigator in showing not only his situation, but also a place of shelter in bad weather. Thirty miles to the northward is

Presque Isle harbor.—This is an excellent harbor, and ought to be provided with a light, to show vessels how to enter it in a stormy night.
All the steamboats bound up or down the lake stop here for wood. The light, if erected, ought to be a colored one. Forty miles from Presque Isle is

Bis Blanc light-house.—It is well situated, and answers an excellent purpose in showing the entrance of Mackinac. Nine miles from this is the

Island of Mackinac.—On a point near the town I have strongly urged the necessity of a beacon; the light to be colored. The passage here is less than a mile wide, with dangerous reefs on both sides. A beacon to direct vessels must, of course, be highly essential. An appropriation for the improvement of Mackinac harbor would be of general benefit to the lake commerce, and I am inclined to think a small sum would render it a very safe place for shelter. Twenty-five miles from this is

Point Wagooshance.—This place is beset with difficulty and danger to the navigator; and, in the hope of rendering it less perilous, I have reported in favor of erecting a light-house on a reef lying near the middle of the passage. It will probably cost from twenty-five thousand to fifty thousand dollars; but the expense is of little moment, when compared with the great advantages to be derived from the work. On passing from the straits, you enter Lake Michigan, leaving the Beaver and Fox islands on the right, and keeping the eastern shore, for the distance of sixty miles or so, until you pass the Manitou island. From thence, to the head of the lake, if a vessel keeps two or three miles from the shore, she will meet no difficulty, except the want of harbors. I may here remark that a light-house is very much wanted on the south end of South Manitou island. It should be a revolving light, to distinguish it from other lights. Vessels bound to Green Bay diverge from the eastern shore after getting about thirty miles from the straits, and pass between the Big Beaver and Fox islands. A common light on the Big Beaver would be very serviceable to navigators, by showing them not only the passage, but places where they could make a lee in heavy weather. At the distance of one hundred miles is the

Entrance of Green bay.—The mouth of this bay is about thirty miles in width, and thickly studded with islands. There are two principal passages, about twenty-five miles apart. In the northern or Loose Island passage, there is a light-house about going into operation, and will, doubtless be of great advantage to vessels coming from or going to Mackinac. The south or Port de Mort passage is used by those who are bound to or from the upper part of Lake Michigan. This passage is without a light, and I beg leave strongly to recommend that one be placed there as soon as convenient. It should be a colored light, to distinguish it from the one in the northern passage. At the distance of thirty miles up the bay is

Chambers island.—This island is exactly in the track of vessels, and as there are shoals, reefs, and small islands, scattered about in all directions near it, I am persuaded a light at this place would be of great utility. At the distance of fifty-five miles from this is the head of the bay, and the mouth of

Fox river.—At the mouth of this river I was induced to place the
light authorized for Green bay, believing it to be more essential than at any other. The commerce of Green Bay is very considerable, and it is highly important that the channel at the mouth of the river should be examined with a view to its improvement. There is an abundant depth of water, but the channel is so exceedingly crooked as to make it very difficult to enter even in the day time, and at night it is entirely out of the question. This channel has been partially marked out at individual expense, but not in a manner to answer the purpose fully. I would therefore suggest that a sufficient number of large spar buoys be placed there by the United States. On leaving the entrance of Green bay, bound towards the head of Lake Michigan, the first point of interest to the navigator is the mouth of

Kewannee river.—This river is distant from the entrance of Green bay seventy-five miles; and its being the most northern point on the west shore where a harbor can be formed, makes it of great consequence to lake navigation. I did not land at this place; but, from all I could learn, the river is of sufficient size to allow of its being made into a good artificial harbor. Twenty miles south of Kewannee you arrive at

Twin rivers.—I did not land at this place, but was close enough to it to discover that the stream was quite large, and doubtless might be used in forming a harbor.

Manitowac river is distant from Twin rivers six miles; at this place the river is of good size, and may be easily formed into a harbor. The town is at present quite small, but bids fair to become a place of importance. I therefore recommend that the proposed light-house should be erected.

Chipewagan river falls into the lake about twenty-five miles south of Manitowac. This stream is large enough to admit of being formed into a fine harbor, and, should there be an appropriation made for that purpose, I am satisfied it would be of general benefit to navigation. I did not hesitate to recommend the erection of a light-house at this point, believing, as I did, that there must soon be large towns at the mouths of all rivers on the lake shores where harbors can be erected.

Milwaukee river empties into the lake about sixty-five miles from Chipewagan. The town at this place was commenced only about three years since, and it now contains upwards of two thousand inhabitants. The commerce of Milwaukee is very considerable, and a light-house and harbor are much wanted. The first they will soon have; but it will be of little advantage, unless they can get a harbor also. The river is large enough for all purposes, and ought certainly to be improved so as to permit vessels of all sizes to enter it.

Root river is situated twenty-five miles from Milwaukee. It is of sufficient size to allow of an excellent harbor being formed at a moderate expense. Here there is quite a flourishing town, containing about four or five hundred inhabitants. It has an exceedingly fair prospect of becoming a place of importance; and should the General Government make a harbor here, it will prove a great benefit and convenience to navigation. The light at this river will be particularly serviceable, not only as a guide to the anchorage, but to warn vessels of a dangerous reef lying about two and a half miles from the shore. The light to be
a revolving one, so as to prevent it from being mistaken for Milwaukee light.

*Chicago* is situated about sixty-five miles south of Root river. This is a highly important place, containing about six thousand inhabitants. There is a good stationary light here, and a harbor nearly completed. It now forms the only place of shelter along the entire western shore of Lake Michigan, and has already been the means of saving many lives and much property. When the piers are finished, the light house ought to be placed on one of them, and the old light should then be discontinued.

*Little Calumet* river is twelve miles distant from Chicago. It possesses no very great advantages, other than its being in the south bend of the lake, and affording sufficient water to allow of a harbor being formed at its mouth. Harbors at the head of this lake are of the utmost importance to the sailor who is so unfortunate as to encounter a gale from any quarter, except from southeast or southwest. A lee shore is met with in all directions, and his only alternative is to beach his vessel; for as to beating off in a flat shallow vessel, such as is usually met with here, it is out of the question. Hence it is that we hear of so many vessels being lost on the lakes, and the great anxiety felt to have places of shelter provided for them.

*City West* is distant from Little Calumet twenty miles. It possesses no great advantages, except being at the head of the lake Fort creek, on which the town is situated, is a very small stream, and, I am inclined to think, unfit for the formation of a harbor. It should, however, be well examined by a competent person, and, if susceptible of improvement, money should not be spared in accomplishing it. A light-house could be of no possible use here at present, and I therefore made an unfavorable report.

*Mitchigan City* is twelve miles distant from City West. It is also in the south bend of the lake, and is quite a large and flourishing town. There is a light-house in progress of construction here, and great efforts are being made to form a harbor at the mouth of Trail creek. What will be the issue it is impossible to say; but it is to be hoped, for many reasons, that it will prove successful.

*New Buffalo* is twelve miles to the northward and eastward of Michigan City, and may also be considered as in the bend of the lake. The Galien river, at the mouth of which New Buffalo is situated, is a fine large stream, and is capable of being formed into as good a harbor as Chicago, and at much less expense. This is a highly important point, when its improvement to the head of the lake is considered, and should by all means be improved without delay, by running out harbor piers. A light-house at this place is needed, and I have recommended that the one intended for City West should be placed here. New Buffalo contains about three or four hundred inhabitants.

*St. Joseph's river* is twenty-five miles north of New Buffalo. Here there is quite a large town and a good light-house. A harbor is now being constructed, and, when finished, will doubtless be an excellent one, as there is a great abundance of water in the river.

*Kalamazoo river* is thirty miles north of St. Joseph's. This is also a
very large stream, and may easily be improved so as to admit the largest-sized vessels. There are several flourishing towns on this river. Of course it is much resorted to, and I therefore reported in favor of a light at its mouth.

Grand river is forty miles north of Kalamazoo. This is by far the largest river that empties into Lake Michigan, having no less than two fathoms water on the bar at its mouth. It is the only safe shelter for large vessels on the east shore south of Manitou islands. Of course I did not hesitate to report in favor of a light here. My examinations here were of a limited nature, but I am inclined to think a small amount would make this by far the best harbor on Lake Michigan. The channel at the mouth only requires to be straightened a little, so as to render it more easy of entrance.

At this place my duties connected with light-houses, &c., ceased, it being the last point I was required to visit. There are several large streams to the northward of Grand river, but I had not an opportunity of visiting them. The shore from Grand river, north, is inhabited mostly by Indians, and therefore but little frequented by vessels.

The service in which I have been engaged during the past spring and summer has afforded me an excellent opportunity to ascertain what would be of most advantage in rendering the lake navigation easy and safe. The formation of harbors at convenient distances along the entire lake shore is a matter of the very first importance, and presents the only mode by which the lives and property of those who are engaged in lake commerce can be secured. It must be remembered that vessels on the lakes have always a lee shore near them, and, being constructed for entering shallow harbors, they are in nine cases out of ten unable to work against even a fresh breeze. Hence the necessity of providing them with places of shelter in a heavy gale.

The travel and commerce on Lakes Erie, Huron, and Michigan, are carried on by about four hundred sail vessels, averaging one hundred tons each, and sixty-five steamers, averaging three hundred tons; making in all about sixty thousand tons. These vessels employ about four thousand persons to navigate them. The number of passengers embarked during one season may be safely estimated at not less than three hundred and fifty thousand.

It is much to be regretted that a different policy has not been pursued in constructing harbors on the lakes. The usual course has been to make small appropriations, and spread the expenditure over a period of several years; and it frequently happens that the sum granted in the spring is barely sufficient to repair the injuries sustained during the winter. Had the appropriations been made in strict conformity with the approved plans and estimates, there is every reason to believe that the public works on the lakes might have been constructed at about one-third of what they have cost. On inquiry, I have learned that about seven hundred thousand dollars have been appropriated by the United States in improving harbors, &c., on Lakes Erie and Michigan. I am satisfied a greater amount of good has seldom or never resulted from a similar expenditure.

The erection of light-houses on the shore, before the formation of harbors, is, in most cases, a useless waste of money. Wherever there are
harbor piers built, it is necessary to place a light on them; and I do not hesitate to say that nearly all the light-house appropriations would have been much more advantageously employed in constructing harbors.

The next subject of general interest to navigation is an accurate survey of the lakes, bays, and harbors. Its necessity is most seriously felt and acknowledged by all, and would be productive of incalculable good. A general survey is highly essential; but should it be impracticable to make it at this time, I would suggest that three partial ones be undertaken—the first to embrace the islands and upper part of Lake Erie, the Detroit river, Lake St. Clair, and the flats at the mouth of St. Clair river; the second, Saginaw Bay and Thunder Bay islands; the third, the straits of Mackinac, the islands at the foot of Lake Michigan, and Green bay. These points include pretty much all the difficulties to be met with, and doubtless there would be many good harbors, passages, &c., discovered, where none are now supposed to exist. A voyage up Lake Michigan or Green bay may still be regarded as one of discovery, for, as yet, they are but little known to navigators generally.

It was a source of regret to me that I was entirely destitute of instruments and conveniences for determining the latitude, longitude, variation of the compass, and depth of water in different parts of the lakes. Much has been said and written on the subject of tides in the lakes, but, from the best information I could obtain, there does not appear to be the least reason for supposing that the ebb and flow discoverable at particular places are caused by lunar or solar influence. In addition to the ebb and flow spoken of, there is also a considerable rise and fall in the entire level of the lakes. These changes take place very slowly, and require the lapse of many years to accomplish them. It is highly important, both for scientific and practical purposes, that careful observations should be made in relation to this subject; and I beg leave to suggest that the collectors of ports be required to make observations, and keep a record of all such changes.

I trust that this report may be found, to some extent, useful to the Treasury Department, and that it may be the means of drawing the attention of our Government to this subject, of such vital importance to the entire lake country. All of which I have the honor of submitting to the board.

I am, respectfully, &c.,

G. J. PENDERGRAST,
Lieutenant of the United States Navy.

Commodore I. CHAUNCEY,
President of the Board of Navy Commissioners.

PASSAMAQUODDY.

NAVY COMMISSIONERS' OFFICE, December 15, 1837.

Although the works authorized at this place have been approved, and no remarks of the board are required by the act of Congress, yet the
nature of the information communicated in the report of Captain Smith, and his recommendations for further measures, seemed, in the opinion of the board, to justify them in transmitting his report, and the documents which accompanied it, for the consideration of Congress.

U. CHAUNCEY.

Portland, June 2, 1837.

Sir: Upon the arrival of the cutter Crawford at Eastport, I immediately continued the prosecution of my duty by an examination of "West Quoddy bay." As this has been determined, by treaty with Great Britain, to be the mouth of the St. Croix river, and its channel, consequently, the boundary line between the United States and the province of New Brunswick, I deemed it of importance to make this examination as critical as the time and means afforded me would allow. This being the only water over which our jurisdiction extends upon our eastern frontier, it is of no small consequence that it be rendered at all times navigable. Such is not now the case. At low water vessels can neither arrive at nor depart from Lubec, Eastport, or the places above upon the St. Croix, by this outlet, but are compelled to go outside the British island of Campo Bello. Indeed, at some places, this channel of the great St. Croix can easily be forded at low water, and a biscuit may be tossed from the American to the English shore. The navigation may, however, be much improved, and although it is difficult to make the channel of a river where nature never intended it, something may be done by human skill and labor to render less difficult the passage of this bay. One of the most serious obstacles is a place called "Smoke-house point."

This point has gradually increased till it extends to the channel. Its formation appears to be of clay and gravel, upon which are lodged boulders of rock, the largest of which probably does not exceed two tons weight. The current upon ebb tide sets directly, and with great force, upon this shoal, which is covered at about one-third flood, and vessels, in spite of all exertions, are often drifted upon and materially injured by the loose rocks lodged there. The constant accumulation of matter which continues to increase this bank, and the current striking it sheering off and forming an eddy, cause a deposit of mud and other matter upon the opposite shore, just below this point, where now a muscle bed has formed and projected into the channel. There appears to be no rock in place at this point. I would, therefore, respectfully suggest the propriety of removing those upon the surface, together with the earth, to allow the current to run a direct course, which, I believe, will keep the channel free, and prevent the lodgement of extraneous matter. The expense I estimate as follows: For removing rock, $350; for removing five hundred squares of earth, at $2, $1,000.

On the upper muscle bank a spindle or buoy, such as have been placed on the bar by Captain Coolidge, of the revenue service, which appear to stand well, is required, which would cost about one hundred dollars.
Upon the lower middle ground, so called, (a sand bank lying in the way of vessels, and upon which, at low tide, there is but about two and a half feet water,) a buoy is required. One of a conical form, I believe, would answer best, on account of the shoalness of the water when the tide is down. It should be moored with two rocks or anchors, and the cost would be about two hundred dollars.

I next visited West Quoddy head. Upon this point or headland a light and fog-bell are now placed, but it seems to me that no one can view this locality with attention without perceiving at once the superior advantages to be derived from both were they placed upon a ledge of rocks called "Sail rock," which lies off Quoddy head about one-eighth of a mile, having a clear passage of bold water on either side of it. This rock possesses the two principal advantages to be considered in selecting sites for works of the kind here spoken of, viz: boldness of shore and conspicuousness of location. Were a light placed upon this rock, vessels would make it much sooner than it is possible now to do, and could run for until close aboard of it, when their precise situation could be judged, and a correct course shaped from it. These advantages, great as they are, for a light upon the rock instead of the head, are much enhanced when applied to a "fog-bell." It is very obvious that a bell upon this rock, extending so much further into the sea, and outside of the surf upon the shore, would be heard at a much greater distance than upon the head, and I have no doubt it could be approached so near that a course might be safely shaped from its sound in thick weather.

The expense of preparing this rock, and fixing a light-house and fog-bell thereon, would be considerable; I am not prepared to say how much, but, in comparison to the benefits, of no moment.

I am informed that sometimes, for twenty days in succession, thick fog is experienced upon that shore, and that often, when it disperses, from fifty to a hundred sail of vessels are seen immediately in the vicinity, having depended upon the fog-bell to give them their position. Indeed, the fog-signal is considered of more importance than the light.

There have been placed upon this head four different bells. The first was of composition, weighing 500 pounds, and struck by clock machinery, made by Willard.

The second was of the same character, weighing 241 pounds, struck by similar machinery, made by Eastman.

The third was of metal, of similar construction, weighing 1,565 pounds, struck by machinery, made by Grueley.

The fourth, now in use, is a cast-steel bar, two and three-eighths inches square, fourteen and a half feet in length, and of a triangular form. Neither has given perfect satisfaction, nor answered the end designed. That now in operation is worse than useless, and cannot be heard much more than a quarter of a mile in heavy weather. Vessels run for the head in a fog, expecting to hear the bell, and often find themselves much nearer the shore than they wish.

Various are the inventions proposed and schemes devised to answer the best purpose for a fog-signal. My own opinion has been fully expressed to you in my report concerning a similar work on Seguin island, and I believe that a sharp-toned bell of 4,000 pounds weight, struck by machinery
properly constructed, and proportioned to the bell, would answer all the purposes of a work of this description.

It is thought by some that the agency of steam will be necessary to strike so heavy a bell as I have proposed; but I am of opinion that a motive power produced by weights can be made to answer every purpose here desired.

I enclose a letter from Captain Coolidge, of the revenue service, whose intelligence and experience in the waters of the coast now considered entitle his opinion to great weight. I also transmit letters from Jeremiah Fowler, Esq., and Samuel Wheeler, Esq.; these gentlemen are competent to judge of the proper facilities for West Quoddy bay, and their statements may be relied upon. The point called “Sharp point” by the latter is the same referred to by me as “Smoke-house point.” The rock off “Green rock,” and nearly to the channel, mentioned by Mr. Fowler, should be removed, and the expense would be about $50.

Respectfully,

JOS. SMITH,
Captain, U. S. Navy.

Com. ISAAC CHAUNCEY,
President of the Board of Navy Commissioners.

Report from the Secretary of the Treasury, in compliance with a resolution of the Senate of the 25th instant, transmitting copies of the representations made to him relative to the light-houses of the United States, by the Messrs. Blunt, of New York, &c.

JANUARY 26, 1838.—Read, and ordered to be printed.

TREASURY DEPARTMENT, January 26, 1838.

Sir: In compliance with a resolution of the Senate, adopted on the 25th instant in the following terms:

"Resolved, That the Secretary of the Treasury communicate to the Senate the representations made to him relative to the light-houses of the United States, by the Messrs. Blunt, of New York, and also the report to him of the Commissioner of the Revenue thereon."

I have the honor herewith to transmit a copy of a communication made to me by Messrs. E. & G. W. Blunt, of New York, dated November 30, 1837, marked A, and the report of the Fifth Auditor and acting Commissioner of the Revenue thereon, dated the 22d instant, marked B.

Respectfully,

LEVI WOODBURY,
Secretary of the Treasury.

Hon. R. M. JOHNSON,
Vice President of the United States,
and President of the Senate.

NEW YORK, November 30, 1837.

SIR: In a letter from R. Ela, Esq., an opinion was expressed by us in general terms, that our Light-house Establishment was badly managed. An extract from our letter came to your notice, and being sent to the Fifth Auditor, produced from him a denial of our statements, and called on us for proof of our assertions.

We feel no desire to hunt out official abuses or neglect; but our business is to give to the mariner information to guide him through his perilous course; to collate and compare the sailing directions and descriptions of coasts and harbors; to inform him of safe and continued reliance can be placed on the efficiency and good management of the lights and beacons of the coast described; and to receive from the intelligent mariner important information to impart to others.

In the course of our inquiries, our attention has been very often called to the situation and management of the many lights provided by our own Government. The amount expended in the erection of light-houses, and the sums annually appropriated for their maintenance, are sufficient, if distributed by a judicious, industrious, and energetic head, to produce all the results claimed in the note of the Fifth Auditor. That these results are not effected, is the object of this paper to prove.

We are satisfied that, on comparison of our light-houses and their management with the similar establishments of France and Great Britain, ours are greatly inferior. We have formed this opinion from a careful examination of the opinions expressed by shipmasters, who are constantly comparing their lights; and they, of all others, are the best judges. Pilots and steamboat captains, who are confined to our own coasts, are, for the most part, incapable of giving correct opinions; for they see none but our poor lights, and seldom, if ever, see the lights of Europe.

The captains of the fine lines of packets from this port to the ports of England and France have a better opportunity of comparing lights than any others. They all concur in opinion that ours are greatly inferior in brilliancy, in the distance they may be seen, and in good management. They have made the inferiority of our lights a subject of complaint for a long while. We have requested a number of them to state their opinions in writing. The papers marked A and B bear the signatures of some of the most intelligent of our shipmasters. No pains were taken to secure signatures, the papers never having been sent from our store.

Two new light-houses have recently been erected at Abaco and Gun Cay, by the British government. They are represented as being very superior lights; and their proximity to our own coast affords a good opportunity of comparison. We have no two lights equal to them. We send in paper B some evidence as to the character of these lights; and, also, a chart of that part of the Bahama bank on which they are placed. Every shipmaster with whom we have conversed, who has seen these lights, speaks in admiration of their power, and the distance they may be seen. They afford a good example of modern British lights. Circumstances relative
to their erection, in some measure, indicate their superiority, and the inferiority of our own lights. The lantern and apparatus for lighting were sent from England; the buildings were contracted for in Boston, whether by the individual from that city who has built so many light-houses on our own coasts we are not informed; but it appears this American mode of building light-houses did not meet the approval of the officer of engineers appointed to superintend them. The contractors broke off, and other parties from Nassau completed them. (See paper D.)

The French light-houses are even superior to the English. Instead of the parabolic reflectors, they use the lens. We beg to refer you to the testimony of Lieutenant Thomas Drummond, given in "Minutes of Evidence taken before the Select Committee on Light-houses, with their report, ordered to be printed, by the House of Commons in 1834, and reference to Sir David Brewster's improvements," &c. We have been for years behind other nations in taking advantage of improvements; but if we were to judge from an advertisement for a contract of the "patent lamps," we should suppose something new was in contemplation. It is nothing but the Argand lamp, with miserable arrangements.

It will be seen, on reference to the remarks on Gun Cay and Abaco light-houses, that an officer of engineers was appointed to superintend the erection of those two light-houses. No such supervision is thought necessary in the erection of our light-houses, and the consequences are evident, in badly constructed buildings. Mr. Winslow Lewis, of Boston, contracted for the building of two light-houses at St. Augustine and Mosquito inlet, on the coast of Florida. The contract, as Mr. Rodman, the collector, informs us, was vague and defective, and the work very slightly done; and the consequence was, that both fell to the ground. We refer you to a copy of a letter from Mr. Rodman to us, marked C. Yet the system which produces such structures is called the best in the world; and the deceived superintendent congratulates himself on its good management.

A dwelling-house connected with the light-house is now being erected at Montauk point. It is by contract. The cellar walls are not laid in mortar, and improper sized stone filled in next the earth. The material, generally, is bad for a work of that kind. This is the opinion of Colonel Livingston, who visited it with Mr. E. Blunt; and the contractor differs in opinion from those who have seen the work, as to the measuring of "the height of the brickwork from the floor," but it is said to be according to contract, and they were not to use the best materials. A new well has been dug, and is said not to be sufficiently deep, by the residents; the old one has been filled up by the contractor, contrary to the wish of the keeper. Now, who is to blame? Certainly not the collector of Sag Harbor; he resides many miles distant, and there is no provision for him to go there to attend to the details. It is the system.

Under the collectorship of the late John P. Decatur, a light-house was erected at Whale's Back near the entrance of Portsmouth harbor; it was built, by contract, of stone. No proper supervision was held over the contractors; it was very badly built, and has recently been boarded
and shingled; as they say in Portsmouth, made into a wooden one. (See paper E.)

In almost every instance where we have seen repairs, they have been unfaithfully done; and on landing at Gull island, one is surprised to see the walls constructed in a faithful manner, after having seen other works.

As far as our knowledge extends, concerning the general management of lamps, &c., there are but few in our own neighborhood which are in good condition, among which are Prince's bay, Plumb island, and Old Field. The lamps in most of the others are bad and leaky. Take Montauk as an instance: the reflectors are of various figures; there is, in all, no proper way of ventilating the lamp-room, and the moisture, mixed with soot from the top of the lantern, freezes on the glass in cold weather.

The light-house, lamps, &c., at Eaton’s neck, have been reported to our own knowledge for eight years; concerning this light, a highly intelligent officer, Lieutenant Blake, now employed in the coast survey, informs us that, having heard many and frequent complaints of this light, he went into the lantern for the purpose of examining it. He there found the lamps very defective, made many years since, and of bad construction; the keeper admitted that the lights were bad, and that he was censured for keeping a bad light; that he had represented the matter to Mr. Pleasonton, and no remedy had been applied. Lieutenant Blake having been employed so long in surveying Long Island sound, and convinced of the exceeding importance of a good light in this particular location, called on the Fifth Auditor, at Washington, and stated, in detail, the imperfections of this light. Mr. Pleasonton informed him he was greatly astonished at this information, and would take immediate steps to redress the evils complained of. Mr. Pleasonton, at the same time, showed Lieutenant Blake a very fine-made lamp and reflector, and informed him that they were a sample of the kind contracted for. Notwithstanding all this, and the knowledge of this light being so defective was so clearly brought to the notice of the superintendent, the light still remains unaltered, and Lieutenant Blake, in visiting it the last summer, a year after his notice, found everything as formerly. Most, if not all, the lamps of this house should have been condemned many years since; the light, for the most part, cannot be seen more than 7 or 8 miles.

The light at the Tortugas should, from its position, be a light of the first class; it has long been noticed by mariners as a very bad one; and we felt justified, in our last edition of the American Coast Pilot, in remarking on the very bad manner in which this light is kept. Lieutenant Gedney, of the United States Navy, who has been much employed by Government about the Florída reef, gave notice to Mr. Pleasonton that the management of this light needed reforming; it still remains a very bad light.

The light at Watch Hill is a very bad one; the lamps are bad, the reflectors too small and of bad figures, and some of them cannot be adjusted. It is a singular instance of ignorance, that before each light there is placed a thick piece of glass, the usual ship-deck light for a
lens. The effect of this is in a great measure to destroy the effect of the lamps.

A few days since, our Mr. Edmund Blunt, engaged in the coast survey service, near this light, noticed that the opposite sides did not show alike, as the machine performed its revolutions, and he requested the keeper to remove for a short time the "lenses," to enable him to see if it was owing to the reflectors. The effect was astonishing; the brilliancy was increased very much, particularly on one side.

One side was increased but little, owing to the light on this side being lost for want of reflectors. When this experiment was tried, the surveyor of the port, Colonel Brown, was present, and remarked that the light increased so much in brilliancy that they would not know what to make of it at Stonington. The machinery of this light is so bad that the revolutions are not regular, and it sometimes requires being turned by hand. This light formerly burned 10 lamps, two of these lamps having two burners each, but owing to some mistake in the contract, they now burn but 8 lights.

The superintendent would not direct the keeper to extinguish two lights, but ordered him "to cause the two double lamps to be so lighted as that no more oil shall be consumed in them than is consumed in any other two of your single lamps." The keeper, being unable to comprehend these directions, was compelled to extinguish two lights.

It is believed many other revolving lights on our coast have this combination of the reflector and a thick piece of glass similar to ship's deck lights, in a similar instance the North Foreland light.

In the language of Lieutenant Drummond, "the result of this arrangement was entirely to destroy the effect of the reflectors, and in fact it was absolutely putting a shade before a very good light. In ordinary cases, a window of the lantern is of thick clear plate glass; but here, instead of the plate glass, they put lens in front of each, which destroyed the parallelism of the beam of light from the reflector, and entirely injured its effect." On the North Foreland light coming into possession of the Trinity House in 1831, these glasses were immediately removed. The light was consequently rendered much more brilliant. In this case an original expense of £750 was incurred to destroy a good light. There is no room for doubt, that the glasses used in our light-houses, and which we understand are similar, though much inferior to those described as formerly used in the North Foreland light, are all injurious to the efficiency of the light; from their construction, they cannot be otherwise. We believe they have been furnished by contracts with Mr. W. Lewis for the most part, and are patented. It would be well worth the inquiry to ascertain the whole cost to the public of this ingenious patent to obscure lights.

We understand that formal, and as we believe, well-grounded complaints, were made by the superintendent of the light at White island, against the keeper, for neglect of duty in not taking proper care of his light, and being long absent from his light-house without permission; leaving it, during his absence, under charge of a female. The complaint was made to the proper authority at Washington. On these complaints, and on other accounts connected with the keeper and known to the inhab-
itants of Portsmouth, a removal from office would have been just, and would have afforded an example to others.

We have, in another place, remarked that there is no examination of the quality of the oil furnished for our light-houses, and intimated that the quality is not generally such as required by the contracts. For winter's use, we believe, pure winter strained oil is contracted for. The heat in the light-room of a light-house is very considerable from the lamps, and the oil must be of very poor quality to congeal. We are informed that the collector at Portsmouth, last winter, despatched a vessel with charcoal to the light-houses at Boon island and White island, to use in the light-rooms, to prevent the oil from being congealed. The accounts in the Bureau of the Superintendent of Lights will furnish some evidence on this point. It is easy to determine the purity of oil, and every cask should be submitted "to a most particular species of trial." While the contractors have the ordering of this matter, every cask will be of the first quality in their reports.

It is, indeed, absurd to believe that a mere bureau at Washington can oversee and manage, in a proper manner, the details of a system of light-houses, beacons, and buoys, for the coasts of the United States. At the commencement of our present system, when the lights were few in number, an energetic man might possibly secure, by great industry, the proper management of our lights. For many years the superintendent has been, in fact, but the head to receive reports from the contractors, and the agent to pay salaries, &c.; his office is, besides, charged with other duties.

The duty of inspection of light-houses built by contract, of overseeing keepers in the execution of their duties, is left to the collectors of districts; these are generally sufficiently engaged in the collection of the revenue, and rarely visit the lights. Nothing of that close and exact supervision, such as is practised in England, is had in this country. The collectors rarely visit the lights. How often, for instance, does the collector of Portsmouth visit Boon island? Not twice in five years! And the same may probably be remarked of Nantucket Great Point light, Montauk Point, and many others. We doubt much if the Mount Desert light has ever been visited by a collector.

The Secretary of the Treasury is very properly placed at the head of the light-house department; but, until the duty of frequent examination and inspection is enforced, our light-houses will remain a reproach to this great country, feebly and inefficiently managed, and at the mercy of contractors.

This examination should be extended to the system in all its parts, from the construction of a light-house, to the lamps, reflectors, and keepers. Officers of the Navy, in many cases, perhaps, in the great cities, committees from chambers of commerce, and individuals disconnected entirely from contracts for supplies, would furnish the material, and frequent and rigid examinations would soon produce a thorough reform.

There are now building sixty or seventy new light-houses. When built, and within a week or so of being lighted, the collectors, if ordinarily diligent, will give public information in the district paper in which the light-house is erected. The information will be gradually diffused; ves-
sels from Europe, the East Indies, and elsewhere, will, on their return, learn that some important light-houses have been erected; they may, in many cases, first discover them on their approach to our coasts, and pay dear for the discovery by shipwreck, as in the case of the "Galaxy."

The frequency of alterations in light-houses, the extinguishing the lights in consequence, and even, in one instance, for want of oil, have been greatly complained of. In the well-regulated public lights of France and Great Britain, alterations are never made without long previous notice. We proceed to notice a few instances of such alterations; premising that, in all cases, we endeavor to become acquainted with their alterations, and give extensive notice accordingly. We have, however, found this oftentimes extremely difficult.

Daniel P. Drown, the collector at Portsmouth, gave notice, not exceeding, we believe, five days previous, that the light on White island, one of the group of the Isle of Shoals, would be extinguished; it was accordingly extinguished for about five days. This is a very important light for vessels bound to Portsmouth from Europe and the West Indies; they often run for and make this light. Previous to the erection of this light, many deplorable shipwrecks took place on the rocks and shoals surrounding this dangerous group. Twenty years since a large Spanish ship was lost, with every soul on board, within one mile of the islet on which is the present light. (See H.)

The ship Galaxy, Captain Goodrich, on her passage from Canton to New York, with a very valuable cargo, was lost near the entrance of this harbor. The light-house at Barnegat was erected and lighted during his absence; the captain made the light, and asserted, on his arrival, that he lost his vessel in consequence of his ignorance of the existence of a light there; having shaped his course believing it another and a well-known light. The first notice we had that the light was lighted, was from a person who saw it in passing. We wrote to Governor Woodbury, then Secretary of the Treasury, to know why public notice had not been given of the same; who, with his usual promptitude, caused the inquiry to be made. We then ascertained that the collector of the district had advertised it in a paper published at Egg Harbor. This light is of sufficient importance to have it considered a light of the first class, and not a mere local one. It is of more consequence to vessels bound to New York than to any others, and notice might almost as well have been put on the door of the building as in an obscure country paper. The Messrs. Griswold, by the shipwreck of the Galaxy, suffered a loss of $50,000, and the revenue a large sum. An intelligent and active superintendent of lights would have caused the most ample previous notice to have been given by our consul at Canton, and the consuls and commercial agents in all foreign ports; and this is the practice adopted, we believe, by the consuls of other countries with us, in similar cases.

We have frequently urged on the superintendent the importance of giving ample notice of the erection and alteration of lights. Our last letter to him, of March 21, 1833, on this important point, has never been acknowledged. In that letter we urged the importance to the mariner and merchant of the earliest possible notice being given.

The light at Mobile point is a very important one. We will hereafter
make some remarks as to the necessity of altering the character of this light at all.

We believe the alteration of Mobile light was made without any previous notice; we have been unable to find any, and Mr. Pleasonton is silent, having confined his remarks to the general necessity, as he thinks, of the alteration. We recollect well this sudden change was a subject of indignant comment among shipmasters. The ship Cahawba, Captain Smith, then a regular trader between New York and Mobile, on her return to Mobile, in forty days from the time she had left that place, found the light revolving, which he had left fixed. He had heard of no alteration being contemplated, and consequently ran by it, and came near being lost. He made the next light west of it, and discovered his mistake, and was four or five days working back. Captain Lake asserts, and so does Captain Hamilton, that they were lying at Mobile bay when the alteration was made, and had no knowledge any change was intended. Captain Bouné, of the Columbus, who was also lying at Mobile, concurs with Captains Lake and Hamilton. We beg leave to refer you to the statements of Captains Lake and Bailey, and to those of Captains Josiah C. Kelly and Nehemiah D. Kelly. See also the paper I, signed by an old and highly respected shipmaster, Captain Snow, of Ship Thames.

It is asserted that the alteration of this light was a judicious one. It seems the alteration was made in consequence of certain reasons furnished by Mr. Winslow Lewis. We are not furnished with these reasons. Some previous complaints being made, it seems Mr. Pleasonton has obtained from "pilots" and "steamboat captains" opinions corroborating those of Mr. Winslow Lewis. In the absence of proof, to be obtained (if possible) from intelligent shipmasters navigating from Europe or the northern ports to Mobile, the opinions of pilots and shipmasters are not of sufficient authority. We send with this a chart for your inspection, and we think on examining it you will agree with us, that the alteration ought not to have been made at all. Whilst it was a fixed light, it could not be mistaken for Pensacola light, which was and is revolving. The light-houses at Cape St. George, and at the passes of the Mississippi, are too far distant to be mistaken. Was it to distinguish it from the light at Cat island, or that at Horn island; two lights only intended to guide small craft and steamboats through the entrances into Dauphin Island sound and Lake Borgne? The old and experienced shipmasters, trading to Mobile, assert the alteration was unnecessary, and, being made without notice, wantonly careless and reprehensible. Mr. Pleasonton seems to doubt the propriety of this alteration himself, for another light-house, he informs us, is in course of erection at Mobile; for what particular purpose we are unable say, but suppose to distinguish it from Pensacola light.

Mr. Pleasonton states that the distance between Pensacola light and Mobile is so great that there is no danger of confounding the two lights; the distance is but forty miles. A few days bad weather, and an error of forty miles, is by no means an improbable one. We have just received an account of a vessel and all hands being lost, by mistaking the two lights at Cape Ann for the two at Newburyport.

The important light at Cape Hatteras, not long since requiring repairs,
was extinguished at very short notice; and an advertisement appeared that a light at Florida would be extinguished for want of oil. Some memoranda respecting the lights at Block island, and at Prospect, Maine, will be found on paper marked G.

In Mr. Pleasonton's letter to Governor Woodbury, he asserts that the complaint respecting the light-ship on Five-fathom bank, off the Delaware, is entitled to no notice, she being always placed by some competent person.

This light-ship was placed in her first position by our Mr. George W. Blunt, under the direction of the collector of New York. Mr. Blunt proceeded to the spot, determined her position by accurate bearings, and on his return, caused the publication in our paper of her precise position. We request you to examine the chart accompanying this, in which her first position is denoted by the engraved figure, and her late position by the figure in ink; such a remarkable alteration deserves especial notice, and to a vessel leaving the capes in the fall and returning in the spring, would be highly dangerous. Pilots are sometimes taken from this ship in the night: supposing a ship in the place on the chart marked X, unacquainted with the alteration, should make the light at night fall, and run for her, to procure a pilot; she would probably give the light a berth of a mile or more to keep well clear of her. She would, in that case, strike the bank, there being but from two to three fathoms. The ship James Cropper, and cargo, homeward bound from Europe, were totally lost on this bank. By what "competent person" the alteration was made, we are not informed. There was but very short notice of the change of place. As soon as we were informed of it, we caused the chart to be altered, and gave notice in our books of directions accordingly. It probably will be learned that the competent person was the light-keeper, whose new position afforded him better shelter from the sea.

We infer, from Mr. Pleasonton's letter, that the restoration of this vessel to her old place was made at his instance, and, by his direction, she is, without doubt, now placed where she should be. But the restoration was made by the instrumentality of the Chamber of Commerce of Philadelphia, who conceived the subject worthy of their interference, as indeed it was. John Vaughan, Esq., a committee of the Chamber of Commerce, wrote us on the subject. (A copy of this letter is marked F.) We have accordingly placed her on her old place, or nearly so, on the chart, and given notice of the change by all the means in our power, but the home-bound mariner will again be perplexed by the change.

On Mr. Duane's coming into office, his attention was directed to the management of our light-houses. It will be perceived he was aware of the imperfections of our system, as appears by a correspondence with him, in 1833, copies of which we annex to this paper. Our views, as then given in our reply, have experienced considerable change. The more recent great improvements in English and French lights rendering the contrast, at this time, still greater than then.

The mode of providing oil for our light-houses is by contract, and this, doubtless, is the best manner to provide for the public service generally, wherever practicable, but requires a constant and rigid supervision and examination. Every cask of oil furnished for the lights of Great Britain
is forwarded to public stores at London, Dublin, or Edinburgh, and from thence distributed, "after having separately undergone a most particular species of trial." There is, we believe, no examination in this country. The oil is generally contracted for at New Bedford, and from thence sent directly to the light-houses. For the good quality of the oil, the superintendent depends on the representation of the keeper; and for good management and proper care of the lights, on the representations of the oil contractors. Here is a novel system of checks, and, as may well be believed, the oil is frequently bad. The keeper of Black Rock Harbor light informed Lieutenant Blake that, in the winter, his oil became congealed, and he was obliged to shovel it out of the cask and render it fluid at his dwelling-house before he could fill his lamps.

Little or no attention is paid to the police of the establishment. In the British public light-houses a light-keeper is required to be in constant attendance during the night, in or near the light-room; he is required to keep a journal; note the times of lighting and extinguishing; the weather, &c. Their lights are frequently visited and examined, and the numerous armed vessels, and the coast-guard service, exercise a constant supervision, and reports are statedly made. The number of lights in the United Kingdom is 219, about the same number that are erected on our coasts, and their preservation and effective management is guarded with jealous care by several public bodies. Yet it is pretended that our establishment is managed in a better manner throughout than that of Great Britain. There is something painful in this delusion. When the lives of our mariners, and vast amounts of property, may depend on the good management of our lights, little reliance should be placed on the representations of oil contractors or light-keepers; in place of this, there should be an exact and uncompromising supervision.

There is little intercourse between light-keepers and the Fifth Auditor, except through contractors. We frequently have complaints made to us of the lights going out, or not being properly attended to. It is not our business to correct the evils complained of; we can only lament that the liberal appropriations of Congress should not have, in a complete manner, the beneficial effect intended.

The machinery of every light-house which we have visited, for producing the revolutions, is of very bad construction. A report on this subject was made by our Mr. E. Blunt, several years since, concerning the light at Fire island, which will be found in the office of the Fifth Auditor.

The material of the lanterns is bad; the frames may be of iron, but the outer part should be of bronze, well soldered on, and no iron in contact with copper, on the outer or exposed part, and the glass should be plate glass.

We venture to assert that, if an accurate description of the lights on our coast were now required, and the particular purpose for which each was erected, it could not be furnished. All this should be in the office of the Fifth Auditor. The collector of Boston, when requested by Mr. Pleasanton to forward a description of the lights of his district, made an extract, and says it is from Blunt's American Coast Pilot, doubtless the best authority; but it seems strange that a description of light-houses
should be \textit{wanting} at the Fifth Auditor's office, when the establishment has been under his charge for over twenty years.

We have not, however, believed the Fifth Auditor's office to be the best source to look for accurate information for a long period. We received, from the Hydrographer of the Admiralty, a request to forward to him a description of our lights, their latitudes and longitudes, magnetic bearings and distances, \&c., \&c.; in short, the information sought for in the paper sent us, marked W. Other good maritime nations take a strong interest in these establishments.

The keepers of our light-houses should be furnished with the time for lighting and extinguishing their lights for every day of the year. The lamps should be examined as often as every four hours, and, in very cold weather, oftener. For lights of the first class, one keeper is insufficient; if the keeper is infirm, he should have two assistants. The practice of leaving the lights for a longer period than twelve hours is forbidden, without permission of the collector; yet it is common, and instances can be pointed out of the absence of light-house keepers from their lights for many consecutive weeks.

There has been published at Washington, by Robert Mills, a small work, called the American Pharos, claiming to describe accurately the lights of the American coast. This work contains many pages of sailing directions, \&c., extracted from the American Coast Pilot, being in some cases extracted by collectors, to whom certain queries were forwarded by the superintendent, and in others pirated by the compiler from the Coast Pilot.

The American Pharos contains many dangerous errors, and is altogether a work on which no dependence should be placed.

The remarks are made on this work from the fact that the superintendent of lights furnished from his office a large portion of the information given in it, and has in a measure given it the sanction of Government authority; and a new edition under Mr. Pleasonton's patronage is promised. We trust this new edition will be carefully examined, and the numerous errors of the first corrected.

At the session of Congress of \ldots, large appropriations were made for new light-houses; a clause was appended to the bill, directing a previous examination to be made by certain naval officers, and providing no light-houses should be erected, unless on proper inquiry they deemed it essential for the commercial interests of the country. We trust this commission will form a new era in our Light-House Establishment, and that it will extend, also, to the location, construction, and management of our lights.

Naval officers of a certain rank are, from their position, well fitted as supervisors of our lights. They know the immense value set on good lights by seamen; their feelings are in favor of this class, and they are far removed from any suspicion of influence from any quarter. A board, composed of three naval captains, clothed with proper powers, would insure the good management of our lights, and promptly report all delinquencies, if any should occur.

The naval captains, selected under the act of Congress above mentioned, were Captains Kearney, Sloat, and Perry, to examine the sites
of the light-houses intended to be erected in and near this harbor. The selection was a judicious one; they addressed circulars to many individuals, and personally examined the sites, and have indicated, in their report, the proper position of the new lights.

The attention of Captain Matthew C. Perry, of this board, was called to the situation of our present light-houses, and he has entered into an elaborate examination of them, their mode of lighting, management, and the comparative expense attending them, with those of other nations. We believe he agrees with us in the opinion expressed in this paper, that our Light-House Establishment is quite inferior to that of France or Great Britain; that the expense is greater; and that, in short, in point of economy, their lights cost less, as well as being far more effective. Without, however, intending to enter into an exposition of what we understand to be his views, we refer you to two papers recently forwarded by Captain Perry to the Navy Department. He has entered into a more careful examination of the expense of our system and foreign ones; and, from his character and position, his opinions will, as they ought, have great weight. We therefore respectfully request that the papers communicated by him to the Navy Department may be examined by you.

One of the new light-houses in this harbor is to be placed on "Flynn's knoll." Flynn's knoll is a sand bank under water, and when this light is completed, it will, with the light on Sandy Hook, indicate the boundaries of the main or ship channel. The practice of building light-houses by contract, in the usual manner, is, in this case, very properly changed; it is placed under the superintendence of Major Smith, of the corps of engineers. It will be an exceedingly important light, and will afford an excellent opportunity of trying the lens used in all the light-houses of France, and which are doubtless superior to the parabolic reflectors used in England, and at much less expense. The whole apparatus should be imported from France. The manufacture of these lenses is a Government concern, and they are not made for sale, but have been furnished by the French government, in several instances, to other nations. It would be necessary to state the kind of light required, the dimensions of the building, &c. Our Mr. Edmund Blunt, when last in Europe, inspected the establishment for the manufacture of lenses. He was furnished with an introduction to Monsieur Fresnel, the superintendent, from the Dépôt de la Marine. Monsieur Fresnel entered fully into every explanation required, and exhibited drawings illustrative of the works. Some glasses resembling ship's deck lights have been introduced into some of our light-houses, and, we believe, called lenses, but, manufactured in ignorance of scientific principles, and of bad metal, have proved worthless.

In locating a light-house, arranging the lamp, and in the appointment of keeper, those living in the immediate neighborhood are too often allowed to have too much influence, save for the lights erected merely for a local purpose. Pilots or steamboat captains should not be consulted.

In the appointment of light-keepers, it is often necessary that other qualifications, besides the capacity to keep a light in good order, should be considered, when the light-houses are in situations remote from
settlements. It frequently happens that the keepers can render assistance to those who are shipwrecked, or to vessels in distress. This was taken into consideration when the merchants of New York recommended Mr. Smith as keeper of Fire Island light. He had been instrumental in saving many lives, and distinguished himself in rescuing the few survivors from the wreck of the Mexico, last winter.

Many of the keepers require a proper boat. We have known cases where a vessel in distress, and very near the shore, was obliged to put to sea again, the keeper of the light being unable to board for want of a boat.

Should it even be thought proper by the Secretary of the Treasury to carry into effect such a close and frequent examination of our light-houses, by a board of naval captains, or others, as suggested in a former part of this paper, we think the commission should include a scientific individual, well acquainted with optical principles, applicable to light-houses. Some proper examination has become indispensable.

It is now half a century since Edmund M. Blunt, Esq., commenced the American Coast Pilot—a work professing, as far as possible, to give accurate descriptions of the coasts and harbors of the United States, and directions for approaching and departing from the same; and the rocks and shoals, and the buoys, beacons, and light-houses, erected to guide the mariner in his perilous course. It becomes not us, his successors, and the publishers of the later editions of this work, to claim for him, or ourselves, other merit than that of an earnest desire to serve the interests of commerce, and render the dangerous course of the mariner more secure; but, as evidence of the value of this work by those for whose benefit it was commenced, and has been continued, there have been published thirteen editions, averaging four thousand copies each; the latter editions being extended to seven hundred pages. For this work we have, in several instances, asked from the Government for information respecting surveys, light-houses, &c., to become the medium to disseminate the same to seamen. Our applications, in some instances, have been refused; in others, unanswered. We have in vain attempted to procure from Washington information respecting light-houses. Several years since we forwarded to Mr. Pleasonton a few letters, addressed to keepers of light-houses, as we knew not how to direct accurately by mail, and requested his assistance. We received from him such a reply as precluded any further similar request.

It is unnecessary here to speak of the general ability and intelligence of our shipmasters, and of the vast amount of property committed to their charge. We owe it to this class of our fellow-citizens, with whom we are so closely connected, to do all in our power to bring to your knowledge the abuses that have crept into the important establishment created for their benefit and the interests of commerce, confident that you will apply the proper remedy.

The establishment has increased beyond the ability of any single individual at Washington to superintend it in its more important details; and the efficiency of the whole has become greatly lessened. The intelligent gentleman who, for so many years, has had the general superintendence of the lights, has had but little assistance of the proper kind;
he has been compelled to rely too much on contractors, and the representations of contractors will always be favorable. The duties of the office of Superintendent of Lights, at Washington, coming immediately under the direction of the present incumbent, have been conducted, to the best of our knowledge, with skill and promptitude; but these duties have been, for many years, almost necessarily confined to the payment of salaries and contractors, and other financial matters; and, there can be no doubt, this least important part of the whole system has been exceedingly well managed. If, in some cases, abuses, when brought to his notice, have not been promptly corrected, his situation may not have furnished him with the necessary means; but the attention of the superintendent has oftentimes been called to the immense importance of giving long previous notices of the intended alterations, and the establishment of new lights. For the most part, this information can be easily given, and cannot be neglected without great risk of human life and the loss of property; and the great number of new light-houses now in progress, renders this duty still more imperative. It remains for him to show that this duty has always been performed, or to give reason for the omission.

We have the honor to be, very respectfully,
Your obedient servants
E. & G. W. BLUNT.

The Hon. LEVI WOODBURY,
Secretary of the Treasury.

Report of the Fifth Auditor, on the subject of the light-houses, in reply to the charges of the Messrs. BLUNT, of New York.

TREASURY DEPARTMENT,
Fifth Auditor's Office, January 22, 1838.

SIR: When, in October last, you communicated to me an extract of a letter from a person with whose name you did not furnish me, complaining of an alteration in the light at Mobile point, and of a change of position of the floating light off Five-fathom bank, and also making a general charge of the extremely defective situation of our light-houses, I pronounced the latter a calumny; and stated, after replying to the particular causes of complaint, that, from all the information I had been able to obtain, I could say, with great confidence, in advance, that no similar establishment had been better kept up generally, or with anything like the economy in the expense attending it. At the same time, I invited the writer, through you, to avow himself, and to bring forward his charges specifically. The writers, it appears, for there were two of them, were E. & G. W. Blunt, of New York, authors of the Coast Pilot, who forwarded their charges through you, under date of the 30th of November last, comprising twenty-seven folio pages, exclusive of documents. I will now proceed to show that the charges are either frivolous, unimportant, or entirely unfounded; and, as they are brought forward in a
grave and imposing manner, I have caused two copies of them to be
made, with my reply; and have to request that you will lay a copy be-
fore each House of Congress.
The charges of these gentlemen may be arranged under the following
heads:
1st. That the light-houses were badly built, and as badly repaired.
2d. That the contractors for supplying oil failed to supply good oil
and to keep the apparatus in repair, as they are bound to do; and that
they made it the interest of the keepers to connive at their default.
3d. That our lights were greatly inferior to those of Great Britain
and France, and were even more expensive.
4th. That the light-house first built at the mouth of St. John's river,
in Florida, and that built at Mosquito inlet, in the same Territory, fell
down from being built badly and of bad materials.
5th. That the light-house at Eaton's neck, in the district of New York,
was suffered, for several years, to be out of repair; that the Watch Hill
light was bad, owing, as they think, to a lens being placed before the
light.
6th. That the light at Mobile point was altered from a stationary to
a revolving one.
7th. That the floating light off Five-fathom bank was placed in a dif-
ferent position from that first given to it, and so as to endanger vessels
passing in and out of the Delaware.
8th. That our oil is never inspected, and that bad oil is frequently
supplied.

There are many other allegations, which will be noticed in the course
of my remarks, or by the superintendents, whose reports are annexed.

On the receipt of this communication, I found it necessary to address
a circular letter to the principal superintendents of light-houses, from
the State of Maine, to Savannah, in Georgia, requiring information as
to the various charges contained in it; and I regret that the delay in
the receipt of their answers has protracted my reply to the present time.
In order to save time, no inquiry was made of the superintendents south
of Savannah, nor of those on the northern lakes. A copy of this circu-
lar bearing date the 12th of December, is hereto annexed, as well as the
answers of the superintendents to whom it was addressed.

As Mr. Winslow Lewis, with whom Congress authorized the Secretary
of the Treasury, in 1812, to contract for fitting up all the light-houses,
(then forty-nine in number,) with his patent lamp and parabolic reflector,
(and they have been so fitted ever since,) was deeply implicated in the
charges made by these persons, both as the inventor of the lamp and re-
slector and as a builder of light-houses, I addressed a letter to him, and
requested that he would return me an answer without delay. His answer
has been received and is hereto annexed, marked A.

To sustain the first general charge, "That the light-houses were badly
built," the Messrs. Blunt refer to the two light-houses built by Mr.
Winslow Lewis; one in the year 1830, at the mouth of St. John's river,
Florida, and another, at Mosquito inlet, built in 1835; both of which
were undermined by the water, and destroyed. In each case, an over-
seer of the materials and work was appointed by the United States, and
Mr. Lewis was not paid until a certificate was produced by him, from our overseer, that the work was well done. Besides these certificates, the affidavits of Mr. Lewis's principal workmen, annexed to his answer, prove satisfactorily that the houses did not fall in consequence of bad materials or bad work. The documents annexed, from Mr. Dill at Jacksonville, show that the one at St. John's fell in consequence of the change of the channel of the river; and it may be stated, that the one at Mosquito inlet fell, because Mr. Rodman, the superintendent, changed the site from where it was fixed by the Fifth Auditor, to a place near the shore, where, in a violent storm, the water was driven on its base, which, being of sand, was washed away and the building fell. A letter from Mr. Dunham, stating the fact, and transmitted by this office to that of the Secretary of the Treasury, and another from Mr. Rodman, acknowledging the fact of a change of site, also transmitted to the office of the Secretary of the Treasury, where, it appears, the letters cannot now be found. An endorsement on the letters, stating the fact, however, has been preserved, and is annexed. For proof of negligence in making repairs, reference is made to Montauk light-house, where some repairs were making, not entirely to the taste of the complainants. Mr. Osborne, the superintendent at Sag Harbor, has put this matter in its true light, for which I refer to his letter, marked B.

It was stated, in a former report from this office, that when a contract was entered into for building a light-house, (and all light-houses are built by contract,) the proper superintendent was directed to appoint a suitable mechanic to oversee the materials and work, and that no payments were made to the contractor until he produced a certificate from such overseer that the work had been faithfully done. This has been an invariable practice, as will be seen by the statements annexed, of all the superintendents who have had light-houses to build. If any better plan has been, or can be, devised for insuring the faithful execution of the work, I have yet to learn it. And, with respect to repairs, no payment is made but upon the certificate of the proper keeper of a light-house that they have been well made. This fact is also established by the letters of the superintendents, before referred to.

Charge 2.—Messrs. Charles W. Morgan & Co., at New Bedford, Massachusetts, who have been contractors for the last five years, and have lately renewed the contract for five years more, for supplying all the light-houses with the best winter and summer strained spermaceti oil, keeping all the apparatus in repair, and supplying every article necessary to keep the light-houses lit, are very wealthy and highly respectable men, engaged in the oil trade; and it is but justice to them to say that, whenever any complaint has reached me of the bad quality of any particular parcel of oil, or of the want of repair of any of the apparatus, which has seldom occurred, they have always, with great promptitude, upon my requisition, substituted good oil, and made the necessary repairs. Testimony of the same character will be found in the letters of the several superintendents annexed.

So far from it being the interest of the keepers to receive and burn bad oil, they know perfectly well, for they have been so informed, that
if they keep bad lights, on the second complaint being made to this office, they would be removed.

Messrs. Morgan & Co., as well as other oil dealers, have assured me that they have never yet discovered any mode of proving the quality of the oil but that of actual use; and this statement is corroborated by the testimony of Jacob Herbert, Esq., before the committee of the British Parliament, in 1834, who states: "I am of opinion that the oil cannot be subjected to any test, so far as I am informed, that is infallible."

Charge 3.—That our lights were greatly inferior to those of England and France, and were even more expensive.

Although our lights are seen, both at sea and in our bays and lakes, as far as is desirable for all useful purposes, for which we are indebted to the parabolic reflector, invented by Mr. Winslow Lewis, of Boston, and which Congress purchased of him in the year 1812, yet I am happy to have it in my power to state, upon the testimony of a considerable number of our most intelligent and respectable masters of vessels, who have been long engaged in trade with all parts of Europe, that there are but three or four lights in Great Britain that can be seen as far as our best lights; and that there are none in France, or any other part of Europe, that can be seen further than any of our lights of the first magnitude. In England, indeed, the same lamp and reflector is in general use, to which they give the preference over the French lenses, as is evinced by a report made to the House of Commons, by a committee of its members, in August, 1834, a copy of which is in my possession. It is not stated in this report how far lights can be seen; but I infer, from some passages of the testimony, that the general distance is from 14 to 15 miles. The Mumbles light is stated to be seen from 5 to 6 leagues.

Of the French light-houses, I am in possession of a list, published in July last by the French Government, showing the latitude and longitude, the elevation of each light-house, and the distance that each is visible. I have caused this to be translated, and herewith send a copy. According to this, their lights can be seen as follows:

- 4 light-houses, visible 1 league, or 3 miles only.
- 17 do. do. 2 do. 6 do.
- 31 do. do. 3 do. 9 do.
- 3 do. do. 4 do. 12 do.
- 6 do. do. 5 do. 15 do.
- 14 do. do. 6 do. 18 do.
- 5 do. do. 7 do. 21 do.
- 3 do. do. 8 do. 24 do.
- 2 do. do. 9 do. 27 do.

There are several more on the list, which can be seen at leagues and fractions of leagues, which I have not noticed; but none of them are visible at a greater distance than the above.

Here, then, are the light-houses which the complainants allege are so much superior to ours, and even superior to those of Great Britain. By referring to the testimony forwarded by the superintendents, corroborated by that of Mr. Winslow Lewis, it will be seen that all our sea
lights from Passamaquoddy to the mouth of the Mississippi, can be seen from 21 to 30 miles. What respect, I would ask, is due to the statements of men so vague and so erroneous, as I have proved those to be of the Messrs. Blunt, in this instance? They are still more unfortunate in alleging that the cost of keeping up the light-houses of the United States is greater than that of Great Britain.

In the report made to the House of Commons in 1834, before alluded to, it appears that the average expense of 36 land lights under the care of the Trinity Board, was £511 sterling, or $2,271 a year. This is understood to include the cost of oil, repairs, and the salaries of the keepers.

The whole expense of the light-houses of the United States, from the 1st of July, 1836, to the 1st of July, 1837, the latest period at which the account can be made up, is as follows:

For repairs .................................. $61,599 00
For oil, and repairing lamps ................. 69,712 00
For keepers' salaries .......................... 76,761 00

$208,072 00

There being 204 light-houses in operation, on the 1st July, 1837, the average of which is $1,014, whilst the average expense of British light-houses, as above, is $2,271, being more than double that of the United States.

Charge 4.—That the light-houses, built at the mouth of St. John's river, and at Mosquito inlet, in Florida, fell down, from being built badly, and of bad materials. This charge has already been noticed in connection with the first charge.

Charge 5.—Relative to repairs to Eaton's Neck light, and to the bad light at Watch Hill.

It is alleged that the keeper of Eaton's Neck light had informed the Fifth Auditor of the dilapidated state of that light-house, and that Lieutenant Blake, of the Army, who had been engaged on a survey on that part of the coast, had called at the office, and had also informed the Auditor of the bad condition of the light-house. It may be that Lieutenant Blake called for that purpose, though I have no recollection of it; but there is no truth in the allegation that the keeper had informed me of the fact, there being no letter from him on file on any subject. It was his duty to have made known to the superintendent, Mr. Swartwout, the condition of the light-house, and this officer denies, as will be seen by his letter, having received any information upon the subject from the keeper.

The first information I appear to have had of the bad condition of the light in question was derived from Captain Polk, of the revenue-cutter Rush, upon whose information I wrote to the superintendent, under date of the 7th June last, of which letter I enclose a copy, to make the necessary repairs, and they have since been contracted for. For the actual condition of the Watch Hill light, I refer to the letter of Mr. Littlefield, the superintendent at Newport, Rhode Island.
Charge 6.—That the light at Mobile point was changed from a stationary to a revolving light.

Whilst this light was a stationary one, frequent complaints were made of its insufficiency, and attempts were made, from time to time, to improve it, without effect. The defect was supposed to be owing to the want of elevation in the tower, and with the view to build one more elevated an appropriation was made by Congress of $8,000. On consulting Mr. Winslow Lewis, however, who had built the existing light-house, he stated that a new light-house was not necessary, and that for three thousand dollars he would fit up the light-house in such manner that it should be the best in the Gulf of Mexico. A contract was made with him, in which he bound himself to exhibit the best light in the Gulf, or nothing was to be paid for it. He adopted the plan of a revolving light, which was pronounced to be the best light on that coast by numerous masters of vessels and steamboats. Complaint was afterwards made, on the part of a few persons at Mobile, of the alteration, as confounding that light with the one at Pensacola, also a revolving light. Mr. Lewis's explanation shows that the lights were so dissimilar that a mistake of one for the other was impossible. Of his letter on the subject, and of certificates from masters of vessels approving of the light in its new form, I annex copies.

Charge 7.—That the floating-light off Five-fathom bank was removed from the original station to the injury and danger of the navigation into and out of the Delaware bay. This vessel having been carried to Wilmington, Delaware, to be repaired, was carried back to Five-fathom bank by Captain Davis, a pilot in our service, and anchored, it seems, in a place different from that originally assigned it. At the instance of the Chamber of Commerce of Philadelphia, she was restored by Mr. Whitely, the superintendent, to her original position, before I was made acquainted with the fact. Colonel Whitely, however, asserts that she was placed but an inconsiderable distance from her original station, and not where the Messrs. Blunt have placed her on the chart. I respectfully refer to his letter annexed, and marked C.

Charge 8.—That the oil was never inspected before delivery at the light-houses. This charge is fully rebutted in noticing charge the 2d, and requires no further explanation.

The complainants state that there is little or no attention paid to the police of the establishment, whilst in the British public light-houses a light-keeper is required to be in constant attendance during the night, in or near the light-room, &c.

By referring to a copy of the standing instructions to the keepers of our light-houses, which was published in connection with a report made to Congress by this office, in January, 1836, and which is again submitted with this report, it will be seen how utterly unfounded is the allegation here made. I am at a loss to know what better regulations could be adopted for the government of the keepers.

The Messrs. Blunt complain that sufficient public notice is not given of the time when new light-houses are to be lit, and even that notice is not sent to vessels in distant seas, even to Canton. How absurd is such a suggestion! In every case of building a light-house, proposals are in-
vited by public advertisement, in which the time is stated when the building is to be finished and fitted up. The owners of ships and underwriters, therefore, are furnished with notice when the building will be lit, as soon as notice could possibly be given, and it would occur to any other persons than the Messrs. Blunt that it would be more proper, as interested parties, for them to give the necessary notice to vessels in which they are concerned.

They recommend that all the keepers be supplied with boats, in order to supply vessels driven on shore in bad weather. This would certainly be very humane, but I do not consider myself authorized to expend the public money for such a purpose. It would, in fact, be making wreckers of our light-house keepers, and might withdraw them from their appropriate duties. Wherever a light-house is situated on an island, I have adopted a rule to allow the keeper a boat, in order that he may draw his supplies from, and communicate with, the main land; but in no other case are boats allowed. There are probably sixty or seventy light-houses thus situated.

Having contrasted the annual average expense attending our light-houses with that attending the light-houses of Great Britain, and shown that the former are conducted with less than half the expense of the latter, it may be interesting and useful to go into a similar comparison as to the cost of the buildings themselves.

In page 74 of the report made to the Parliament, before referred to, it appears that eleven light-houses under the Trinity Board, built between the years 1820 and 1823, cost the enormous sum of £217,335 sterling, being an average in dollars of $87,721 each.

By a rough calculation which I have made, the average cost of building the light-houses of the United States, since I have had charge of the establishment in the year 1820, is the inconsiderable sum of $6,000; most of our appropriations not having exceeded $5,000.

It may be proper to say something in regard to the lens used by the French government in their light-houses, and which are referred to as being superior to any other mode of lighting light-houses by the complainants.

Having heard these lenses spoken of with great approbation by persons who had visited France, and as it was alleged they were to be had at a cheap rate, I was induced, some years ago, to write to one of our agents at Paris, to procure from Mr. Fresnel, the secretary of the board of roads and bridges, who had charge of the French lights, a set for a light-house of the first magnitude, and also one for a harbor light, if they could be had at a reasonable rate. I was informed, in reply, that a set for a light-house of the first class would cost about $8,500, and one for a light of the third rate about $2,000. As our lights from the reflector were satisfactory, and my chief object was economy, I declined ordering a set of the lenses, as our reflectors and lamps would not cost more than one-sixth as much. The event has proved that I acted correctly, as those lenses, although very expensive, are not suitable for stationary lights, but are recommended for revolving lights only. This is the opinion of Captain Drummond, as stated to the committee of the House of Commons, and will be found in their report, page 32. It also appears
by the French list of light-houses, to which I have already referred, that a great majority of their lights, fitted up with the lens, cannot be seen as far as ours fitted up with the reflector.

Upon this subject it is also proper to bring to view the testimony of Robert Stevenson, Esq., charged with the management of all the light-houses in Scotland, and who is represented to be a gentleman of great experience and science, before the committee above referred to. It will be found in page 114. Question by the committee: "What is the result, at the present moment, of all your observations as to the most economical and best light that can be used? Consider them well. Answer. In the present state of my information, the result of my information is, that the simple Argand burner and reflector, as now used, is, on the whole, the most economical and the most manageable of any of the other systems of lighting with oil. The gas, I think, a very uncertain mode of lighting an establishment of that kind. When I visited Holyhead, in October last, I found the gas-house partly unroofed. They had had an explosion a day or two before I arrived, and that had been the third accident they had had; one man had been killed, and others narrowly escaped."

With a view to economy, some years ago, I engaged a gentleman well acquainted with the making and application of gas, and who had, in fact supplied the principal hotels and other public houses in Baltimore with gas-light, to fit up the light-house at Point Lookout, at the mouth of the Potomac, which was then just built, with gas apparatus, and make report to me of the expense and the practicability of using gas-light in the light-houses. He accordingly made the experiment, and reported that the expense would be about equal to that of oil, but that the apparatus would be so liable to get out of order, that it would not be advisable to adopt that mode of lighting our light-houses. It was accordingly relinquished.

Captain Drummond's experiment with lime balls also failed. He placed a lime ball, three-eighths of an inch in diameter, in the focus of a reflector, and ignited it with a mixture of hydrogen and oxygen gases. The light given out, when intensely heated, was stated to be 264 times greater than that from the Argand burner, supplied with the best oil. He could not recommend its application in its present state. The chief difficulty was in keeping up a constant supply of lime balls, which were rapidly consumed, and also in keeping the supply of the two gases properly regulated. (Page 33.)

It will not escape your attention, sir, that at the bottom of all these fallacious and unfounded charges against the management of our light-house establishment, brought forward by the Messrs. Blunt, is the desire expressed by them of producing a transfer of this important branch of the public service from this office to a board of three Navy captains; and I regret to perceive, from the statement of these gentlemen, that Captain Perry has favored their views so far as to write two letters to the Secretary of the Navy, denouncing our light-house system and its management.

Our Navy officers stand deservedly high in the line of their profession, but it is not perceived how they can be particularly well qualified for
managing a light-house establishment. In the old establishments of England and France, there does not appear to be a single officer of this profession employed in directing and controlling the management of their lights.

So far from this being the case, the fact is that in England, out of a board of thirty-one members, called the Trinity Board, there is not an active member of that profession employed in it. Of the thirty-one members, twenty are charged with the duty of conducting the light-house establishment, and all of them are represented to have been masters of ships in the merchant service, engaged in foreign trade, and eleven of them honorary members; and to consist of admirals in the Navy, ministers of State, and other persons of distinction. Here, then, naval officers appear to have been studiously excluded from all active participation in the direction of their light-house system.

In France, their light-houses are managed by what is called the administration of bridges and roads, who are put under the general control of the Minister of State for the Interior. There does not appear to be a single naval officer employed in this department of their service.

Having been charged with the light-house establishment of the United States for the last 18 years, and built it up from 55 to 210 light-houses, (two having been completed since my last report,) with the addition of 28 light-ships, with a large number of beacons and buoys, and kept the whole in a condition of which I feel proud, at an inconsiderable expense, I feel fully warranted in recommending that, if the legislature should at any time think proper to take this business out of my hands, they will not place it in the hands of a board of any kind, but in the care of a single person, who is honest, temperate, has good common sense, and is devoted to business.

I cannot close these remarks without paying a just tribute to the valuable services of Mr. Winslow Lewis, of Boston, to whose experience and knowledge in all that relates to light-houses, I have been greatly indebted for the present and past good condition of the whole establishment.

When I took charge of it, I found him employed, under a contract entered into. I believe, with Mr. Gallatin, to supply all the light-houses with oil, and to keep the apparatus in repair. As soon as it expired, I determined to open the door to all who might be disposed to bid, and accordingly I advertised for proposals for five years, when Mr. Lewis was underbidded in a small amount, and lost the contract. Very fortunately, however, it was taken by wealthy oil dealers at New Bedford, and has been successively taken by different gentlemen at the same place, and of the same occupation, all of whom have fulfilled their contracts in a satisfactory manner.

Mr. Lewis’s services were still valuable to me, in building and fitting up light-houses, in all cases where he was the lowest bidder, as he often was; but more particularly in securing the foundation of such light-houses as were threatened to be undermined, by the encroachment of the sea upon them, in which his experience and science as a civil engineer were very useful.

I regret that the illness for some time past, and the recent resignation of David Henshaw, Esq., the superintendent at Boston, will in all probability deprive me of answers from him to the interrogatories contained
in the circular from this office. He is a gentleman who felt a pride in discharging all his duties promptly and faithfully, and I took great pleasure, at all times, in transacting business with him. The want of his testimony, however, will, in a great measure, be supplied by that of Mr. Winslow Lewis, to which I have referred, and that voluntarily forwarded to me by the Marine Society of Boston, which I beg leave to transcribe, viz:

"At a meeting of the Boston Marine Society, held on the 2d of January, 1838, it was

"Voted, That, in the opinion of this board, the general character of the lights on this coast is good, and that much credit is due to the department, under whose superintendence the light-houses are placed, for the good order which the light-houses now evince, and the exertions used to maintain efficient light.

"Voted, That the secretary be requested to transmit a certified copy of this vote to Stephen Pleasonton, Esq., Fifth Auditor and acting Commissioner of the Revenue, at Washington.

"A true copy of the record:

"THOMAS ENGLISH,
"Sec. Bos. M. Society."

Another communication, of much interest, which I expected to receive from Messrs. Charles Morgan & Co., at New Bedford, has been delayed in consequence of the absence of one of their principal agents, who is on a visit to all the light-houses on the coast, and may not return for a month to come. When that communication shall be received, however, I will take care to cause it to be transcribed and forwarded to Congress as a part of this report.

FLOATING LIGHTS.

Having gone into an examination of the light-houses of the United States on the seacoast, and shown their present condition, it seems to be proper that some notice should be taken of the floating lights also.

On the first of July last twenty-four of those lights were in operation, and for the year preceding they cost, in repairs and the wages of officers and seamen, the aggregate sum of $62,408, viz:

In repairs and seamen's wages.......................... $50,058 13
For twenty-four keepers' salaries......................... 12,350 00

$62,408 13

being an average of $2,600 for each; whilst in the British service the average of each of their light-vessels is stated to be £1,334 sterling, or £5,922.

Since the 1st of July last four new light-vessels have been completed, making in all twenty-eight, of which, and their respective stations, I have annexed a list.

It will be perceived, by recurring to the annual cost of the light-houses, that twenty-four light-vessels cost nearly one-third as much as two hundred and four light-houses, demonstrating very clearly that they ought not to be employed in any situation where it could be possible to erect a light-house at a reasonable expense. As these vessels, when at
their stations, always lie with their bows to the wind, it is impossible to
air the hold sufficiently to prevent dry rot in the timbers; and it is
found, to the southward particularly, that every four years they become
so much decayed as to cost nearly as much in repairs as would build
new vessels. I have adopted every regulation which occurred to me as
proper for preserving them, but without effect, as will be seen by the
standing instructions to the masters or keepers, of which a copy is
annexed.

I have the honor to be, very respectfully, sir, your obedient servant,
S. PLEASONTON,

Fifth Auditor and acting Comm'r of the Revenue.

To the Hon. LEVI WOODBURY,
Secretary of the Treasury,

Documents in relation to the Light-house Establishment.

MARCH 3, 1838.—Referred to the Committee on Commerce, and ordered to be printed.

IMPROVEMENT OF LIGHT-HOUSES.

Rejoinder of E. and G. W. Blunt, to the reply of Mr. Pleasonton to their
communication to the Secretary of the Treasury, on the subject of
light-houses.

NEW YORK, February 22, 1838.

On the 30th of November last, we had the honor to address the Secre
tary of the Treasury on the subject of light-houses; in which we, in
substance, stated, that our light-houses were greatly inferior to those of
Great Britain and France; that the system of superintending them and
their management was bad; and that the establishment was kept up at
greater cost than those of some other nations, particularly of France.
Our communication, without any agency of ours, was laid before Con
gress, and our statements denied in the reply of the Fifth Auditor. We
shall proceed to show that, in all our statements, we were correct, and
mainly from documents furnished by the superintendent.

The superintendent relies, almost exclusively, on statements and
depositions furnished by Mr. Winslow Lewis, of Boston, a gentleman
who, for many years, has had the furnishing of “patent lenses,” “patent
lamps,” “patent parabolic reflectors,” and erecting light-houses.

The main point of our statement, that our lights are generally inferior,
Mr. Pleasonton endeavors to show is erroneous, by giving the distance
that each French light is visible, and comparing them with the distance
Mr. Lewis states the American lights can be seen; and he then asks,
“What respect is due to the statements of men so vague and so errone
ous as I have proved those to be of the Messrs. Blunt?”

Unfortunately for Mr. Pleasonton, he proves too much; for the dis
tance at which any object may be seen, or the limits of extreme visibility,
is determined by the figure of the earth; and it is demonstrably impos
sible for an observer at sea, at any attainable height, to discover lights
at the distances he pretends. It will be seen by Mr. Lewis’s letter of
December 30, that he, himself, has seen these lights at the distances
named by him, “corroborated by the observations of a vast many
others;” and Mr. Pleasonton draws from this letter, and these given
distances, his main argument, that he is so fortunate as to superintend a most excellent establishment.

We take the list of light-houses from Mr. Lewis’s letter, and from Mills’s book on light-houses; the materials of which work, Mr. Pleasanton informs us, were furnished by him to Mr. Mills; and, applying the rule in Vince’s Astronomy, and allowing for terrestrial refraction, as by Dr. Bowditch’s tables, we give the distance objects may be seen of known heights, at two different elevations of the observer; at which distances the curvature of the earth determines the limits of visibility, except in very rare cases, and under circumstances of extraordinary atmospheric refraction. We give these distances in nautical miles and hundredth parts; and in another column, the distances stated by Mr. Lewis.

Statement of the distance of terrestrial objects at sea, in nautical miles, or the limits of extreme visibility, calculated by the rule given in Vince’s Astronomy, and allowing for terrestrial refraction, taken from Dr. Bowditch’s Practical Navigator, and reduced to nautical miles.

<table>
<thead>
<tr>
<th>Height of the object</th>
<th>Eye of the observer may see, nautical miles and hundredths</th>
<th>Eye of the observer may see, sea miles and hundredths</th>
<th>Distance stated by Mr. Lewis, as having been seen by him.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 feet at Gulf island</td>
<td>12.50</td>
<td>16.55</td>
<td>24</td>
</tr>
<tr>
<td>53 do. Wood island</td>
<td>12.74</td>
<td>16.78</td>
<td>24</td>
</tr>
<tr>
<td>55 do. Mobile</td>
<td>12.89</td>
<td>16.94</td>
<td>30</td>
</tr>
<tr>
<td>60 do. West Chop</td>
<td>13.27</td>
<td>17.32</td>
<td>24</td>
</tr>
<tr>
<td>70 do. Beon island</td>
<td>15.03</td>
<td>18.03</td>
<td>25</td>
</tr>
<tr>
<td>74 do. Point Judith, Sapelo island</td>
<td>15.29</td>
<td>18.29</td>
<td>21</td>
</tr>
<tr>
<td>75 do. Ocracoke</td>
<td>14.31</td>
<td>18.36</td>
<td>27</td>
</tr>
<tr>
<td>78 do. Frank’s island</td>
<td>14.51</td>
<td>18.57</td>
<td>27</td>
</tr>
<tr>
<td>80 do. Cape May, Cumberland island</td>
<td>14.64</td>
<td>18.68</td>
<td>25</td>
</tr>
<tr>
<td>Pensacola</td>
<td>14.64</td>
<td>18.68</td>
<td>27</td>
</tr>
<tr>
<td>82 do. Boston</td>
<td>14.76</td>
<td>18.81</td>
<td>30</td>
</tr>
<tr>
<td>87 do. Plum island</td>
<td>15.05</td>
<td>19.10</td>
<td>21</td>
</tr>
<tr>
<td>89 do. Fire island</td>
<td>15.29</td>
<td>19.24</td>
<td>27</td>
</tr>
<tr>
<td>90 do. Portsmouth</td>
<td>15.35</td>
<td>19.30</td>
<td>24</td>
</tr>
<tr>
<td>Passamaquoddy</td>
<td>15.35</td>
<td>19.30</td>
<td>27</td>
</tr>
<tr>
<td>White island</td>
<td>15.35</td>
<td>19.30</td>
<td>21</td>
</tr>
<tr>
<td>Thacher’s island</td>
<td>15.35</td>
<td>19.30</td>
<td>27</td>
</tr>
<tr>
<td>90 do. Sandy Hook</td>
<td>15.25</td>
<td>19.30</td>
<td>30</td>
</tr>
<tr>
<td>95 do. Cape Hatteras</td>
<td>15.56</td>
<td>19.60</td>
<td>24</td>
</tr>
<tr>
<td>Cape Lookout</td>
<td>15.56</td>
<td>19.60</td>
<td>24</td>
</tr>
<tr>
<td>98 do. Newport</td>
<td>15.73</td>
<td>19.78</td>
<td>24</td>
</tr>
<tr>
<td>100 do. Tybee</td>
<td>15.84</td>
<td>19.89</td>
<td>24</td>
</tr>
<tr>
<td>110 do. Baldhead</td>
<td>16.40</td>
<td>20.45</td>
<td>21</td>
</tr>
<tr>
<td>130 do. Cape Henry</td>
<td>16.90</td>
<td>20.95</td>
<td>27</td>
</tr>
<tr>
<td>136 do. Charleston</td>
<td>17.24</td>
<td>21.29</td>
<td>24</td>
</tr>
<tr>
<td>140 do. Cape Elizabeth</td>
<td>17.93</td>
<td>21.93</td>
<td>24</td>
</tr>
<tr>
<td>155 do. Race point</td>
<td>18.55</td>
<td>22.60</td>
<td>28</td>
</tr>
<tr>
<td>160 do. Montauk</td>
<td>18.87</td>
<td>22.92</td>
<td>30</td>
</tr>
<tr>
<td>163 do. Seguin</td>
<td>19.00</td>
<td>23.05</td>
<td>24</td>
</tr>
<tr>
<td>170 do. Monhegan</td>
<td>19.34</td>
<td>23.36</td>
<td>21</td>
</tr>
<tr>
<td>172 do. Gay Head</td>
<td>19.40</td>
<td>23.45</td>
<td>21</td>
</tr>
<tr>
<td>180 do. Cape Henlopen</td>
<td>19.75</td>
<td>23.79</td>
<td>30</td>
</tr>
<tr>
<td>200 do. Cape Cod</td>
<td>20.36</td>
<td>24.61</td>
<td>24</td>
</tr>
</tbody>
</table>
Mobile light, it is stated, may be seen 30 miles; to see this light at this distance, the eye of the observer must be 348 feet high. Boston light, Mr. Lewis says, may be seen 30 miles; he must then have been 289 feet high; even to discover Seguin light, 30 miles distant, which is 163 feet high, the observer must be 177 feet high; and to perceive the lantern or light at Cape Henlopen, elevated 180 feet above the level of the sea, Mr. Lewis must himself have been elevated in the air no less than 160 feet. It were useless to waste words in the further refutation on this point.

His witnesses are no less unfortunate. Robert B. Edes certifies that five certain lights may be seen in Boston bay, "the distance across the bay being 18 leagues, or 54 miles;" the distance across this bay is but 44 miles, as may be determined by the chart.

Daniel Hood, on oath, testifies that he has seen several lights on the coast of Maine at the same time; "from Boon island to Seguin is nineteen leagues." This distance is but 47 miles.

In an account of the Irish lights, made by George Halpin, in 1834, the height of all the light-houses on the Irish coast, from the level of the sea, is given. He gives, also, the distances at which these lights, thirty-seven in number, can be seen. The distances, in most cases, approach the limit of extreme visibility, but none are stated as going beyond it. Mr. Winslow Lewis, and some of his witnesses, can only perform this miracle; the superintendent being the general voucher. Capt. J. M. Pelby, in minutes of evidence taken before the select committee on light-houses, (Parliamentary Reports, page 197,) states "that the argand lamps, with parabolic reflectors, may be seen as far as the curvature of the earth will allow their being seen." To Mr. Winslow Lewis we are indebted for seeing objects much farther.

Cordouan light, at the mouth of the Garonne, is a revolving light of the first order. It is represented by seamen, and men of science, as being the best light of any in the world, being fitted with the best modern improvements, with lenses and mirrors. The lantern is 197 feet from the level of the sea; and Mr. Pleasonton, in his table as translated, informs us can be seen 27 miles; one other light only, on the French coast, being seen so far. An observer at the masthead of a vessel, about 55 feet from the level of the sea, could discover this light just 27 statute miles off, and it then would appear at the edge of the horizon; and yet Mr. Winslow Lewis would have us believe Mobile light only 55 feet high, can be seen 30 miles. The actual height of the eye of the observer, in the case of the Cordouan light, above mentioned, we are informed by Legrand, director general of roads and bridges, was 20 metres, or 67\(\frac{3}{4}\) English feet.

Conway Whittle, superintendent of lights at Norfolk, states that Cape Henry light may be discerned on the verge of the horizon, varying from 10 to 18 miles; the greatest distance 18 miles. Mr. Lewis, in his table, makes it 27 miles.

Having demonstrated that it is impossible the statements of Mr. Lewis can be correct, and on which statements Mr. Pleasonton's justification is almost entirely founded, we proceed to furnish some direct testimony as to the general inferiority of our lights.
The letter of Collector Reckless, sent Mr. Pleasanton, states that Sandy Hook light cannot be seen over 12 miles, and the Highlands of Navesink from 18 to 20 miles; and that all of the owners and captains of packet ships, who are constantly trading between the ports of Great Britain and the United States, concur in this statement.

* * * * * * * *

It is remarkable, in analyzing the testimony submitted by Mr. Pleasanton to prove that our lights are equal to those of France and Great Britain, to find his witnesses almost exclusively confined to the masters of coasting craft, and shipmasters long retired from active command. The great improvements of foreign lights have been made within a few years. Capt. Crocker, a retired packetmaster, states "that those lights where they use coal are not so good as where they use oil with reflectors." It is well known the use of coal for light-houses has been discontinued for many years. The testimony of thirty-six pilots and captains of coasting craft certify only that the light on Mobile point is superior to any other light on "the coast of Florida."

Mr. Pleasanton denies that there are any great recent improvements in the management of light-houses in Europe; and, in page 33 of his reply to our first communication to the Secretary of the Treasury, refers to the testimony of Robert Stevenson, Esq., commissioner of lights in Scotland, in Mr. Stevenson's report to the committee, published in 1835. Mr. Stevenson alludes to his previous statements; explains his former testimony; and, in direct contradiction to his opinions, as stated by Mr. Pleasanton, says, that in fixed lights the French apparatus produces at least three times as much light, by the combustion of the same quantity of oil, as the argand lamp with reflectors, and that the great superiority of the method with lenses, rests upon its fulfilling perfectly the condition required in a fixed light, by distributing a more intense light equally in every point of the horizon. We beg leave to refer you to papers marked G, for further evidence on this point. Mr. Pleasanton, we think, has no knowledge of Mr. Stevenson's report, or he never would have stated the lens as not suitable for stationary lights.

Having, as we believe, adduced abundant evidence that our lights are inferior to those of Great Britain and France, it may be thought unnecessary to proceed any farther, believing that the proper steps will be taken to place our establishment in as good condition as that of these great commercial nations; but, as the Superintendent of Lights has denied the other statements made by us, and assumed charges never made by us, to disprove them, we may be permitted briefly to review them; meanwhile, we entirely deny the inference endeavored to be fastened on us by Messrs. Lewis and Pleasanton, of a general charge of fraud against contractors. It is the defective system we complain of, and of there being no proper superintendence.

The first charge, as stated by Mr. Pleasanton, that light-houses are badly constructed; Mr. Rodman's testimony on page 19, respecting two light-houses in Florida, is conclusive. Mr. Lewis, in denying this statement, misquotes the language used by Mr. Rodman. He adds the important words "at Mosquito," in the ordinary marks of quotation, and then denies statements not made by Mr. Rodman.
Black Rock light-house is notoriously badly built.

To illustrate the system, we refer to a document furnished by Mr. Pleasonton. Collector Whittle (page 59, Senate document 138) says: "It may serve to illustrate best the necessity of such a measure, and the frauds which may be occasionally practised, for me to state, that, in the occasional necessary absence of this person while the work was in progress, he would observe that it was greatly advanced in the interval; until sounding the brick-work he found was recent, the bricks would leave the mortar, and become buried in the wall. Having caused the place to be opened, the cause was apparent; the space between an inner and outer facing of brick being filled in with sand, into which the bricks sunk."

The sum paid for repairs for one year, ending July 5th last, was $61,600, while the whole cost of maintaining all the light-houses for that year was $208,072; a charge for repairs much too great, on the supposition that the buildings are constructed in the best manner.

2. That the contractors for supplying oil failed to supply good oil, &c. We made no such charge; we complained there was no examination of the oil, and gave some instances of bad oil, &c.

The present contractors, Messrs. Morgan & Co., of New Bedford, we do not know personally, but know them to be men of high respectability. If, under men of the high character of Messrs. Morgan & Co., bad oil is sometimes furnished, what may be expected should contractors fall into less scrupulous hands? That bad oil is sometimes furnished, Mr. Pleasonton gives us abundant evidence. Mr. Littlefield, collector of Newport, says: "In the year 1835 several complaints were made in respect to oil;" that the winter oil remaining at Newport was complained of as "very poor;" that at Block island of "second quality;" that at Dutch island as "very bad." William Frick, superintendent at Baltimore, says that whenever "the oil has been complained of, a better quality has been promptly supplied." John P. Norton, superintendent at Edgartown, says, "oil for the most part good; when bad they have never refused to remove it, and supply good." John Anderson, superintendent at Portland, says, "whenever complaint has been made of the oil, they have taken it away, and supplied such as was wanted." Samuel Swartwout, collector of New York, says, "occasional complaints are made by keepers of the inferior quality of the oil, which has been forthwith replaced by contractors." I. W. Crawford, superintendent of New London, says "the contractors have usually kept the lamps and apparatus in a tolerable state of repair. It is believed they have not always furnished oil of so good a quality as their contract requires." A. B. Fannin, collector of Savannah, says, "the contractors at New Bedford have not given altogether as much attention to the lamps, apparatus, and quality of oil, as I could have wished." Henry Whitely, superintendent at Wilmington, says, "that the contractors have, in every instance, supplied good oil in place of that reported bad."

The contractors in every case, we have no doubt, intend to furnish good oil; but the supply for the year being for the most part furnished at once, it is evident, if they unfortunately furnish bad oil, it must be used for a long while before there is a possibility of exchanging it. A proper system of
inspection would prevent this evil, and that such system is entirely practicable.

The light at the Tortugas was complained of by us in September, 1833. We then stated it was wretchedly kept, and, indeed, could seldom be seen until a vessel was in a dangerous situation. Mr. Lewis admits this light has never been in good repute, "though fitted up with the same kind of reflectors and lamps as Key West."

John P. Osborne, collector at Sag Harbor, states "that the reflectors at Montauk are of various figures, and have been so long as I have any knowledge of them, and have been so reported five years ago," and that some of the lamps are poor. He says, also, the Gull Island lighting apparatus has been unfit for use for the last eight or ten years."

The third charge, as stated by Mr. Pleasonton, as made by us, respecting the general inferiority of our lights, we have abundantly proved in the first part of this paper, and the references of shipmasters and others.

The fourth charge refers to the light-houses mentioned by Collector Rodman; his testimony is conclusive, as previously mentioned.

The fifth charge refers to the light-house at Eaton's neck, and Lieu- tenant Blake's information. This gentleman is now at Washington, and his testimony there can be had, if required.

The Superintendent states our sixth charge to be that of altering Mobile light. The important fact of altering this light, without notice to the public, he takes no notice of; we particularly dwell on the alteration of this light and the light-ship at Five-fathom bank in our first letter, and asserted this alteration without notice to be "wantonly careless and reprehensible," and gave abundant evidence from shipmasters accordingly. An extraordinary circumstance appears in the correspondence submitted by Mr. Pleasonton; he himself was first informed that the character of Mobile light was changed by a Mobile newspaper, and informs Mr. Lewis he is very sorry he had made the alteration. We asserted in our first communication that for many years the duties of the Superintendent had been confined to the payment of salaries, &c., and that the actual superintendent was in other hands. Could stronger evidence of this be adduced than is shown by Mr. Pleasonton's letter? One of the most important lights on our coast changed from a fixed to a revolving one, at a short distance from another revolving one, for which it was immediately mistaken, without notice to the public; the Superintendent of Lights ignorant of it, and this by the sole direction of a contractor. (See the evidence of Captain William Bowne.)

He, also, was ignorant of the change of location of the light-ship at Five-fathom bank, which, he informs us, was done by direction of a Mr. Davis, a pilot.

How differently such alterations and changes are made in England and France. By a government decree of the latter, Article 3, it is ordered, "No new establishment of light-houses, lights, or sea marks, shall be proceeded in otherwise than from plans agreed upon by the Minister of the Interior and of the Marine; so also shall it be in respect to any alterations that may be contemplated either in the dimensions or lighting of light-houses or light-vessels, as well as in the position of sea-marks actually existing." By Parliamentary reports, so often alluded to, it
seems to require an act of Parliament to alter a light once established in Great Britain. (See the evidence of C. Cunningham, page 88.)

"Unless the characteristic appearance of a light be invariably the same, it could not answer the great purpose of distinguishing the place where it stands from the other parts of the coast and the mariner could never tell where he was or what light he had in view. The great object of a light is to indicate by its certain and invariable characteristic appearance the point of land where it stands, in the same way that a beacon of a particular form points out its own locality by day. To change the appearance, therefore, of a light at particular times would deprive it of all its use, and might be the means of leading vessels directly into danger, by causing the seaman to mistake one place for another."

Mr. Pleasonton informs us that it would occur to any other persons than the Messrs. Blunt, that it would be more proper for the owners of ships and underwriters, "as interested parties," to give notice of the lighting of new lights. We think this is entirely a new view of the duties of an officer called Superintendent of Lights, and new to the public, "owners of ships and underwriters," as well as ourselves. Alan Stevenson informs us, in relation to French lights, as soon as a new light is ready the administration causes advertisements to be made in the most extensively circulated journals of Paris, containing a notice to mariners regarding the position, appearance, and time of exhibiting the new light. This notice is also circulated in every French port, by means of placards, which are affixed by the maritime authorities, and generally appear about three months before the exhibition of the new light.

The seventh charge relates to the changing of the light on Five-fathom bank, without previous notice, proved and admitted by Mr. Pleasonton to be done without his knowledge, by a Mr. Davis, a pilot.

The eighth charge, "That our oil is never inspected, and that bad oil is frequently supplied." This charge is comprised in the second charge. It is admitted there is no inspection of the oil, but it is asserted an inspection is impracticable. We refer to the certificate of oil dealers of this city, already alluded to, and to the evidence in our first letter, relative to the inspection of oil for light-houses of Great Britain.

Mr. Pleasonton informs us, by his letter to us of October 28, that he has "been gratified to find that most of our lights can be seen farther than theirs, (England and France,) and our system is conducted at less than one-half of the expense." We are informed that the annual expense of our lights was, in 1836, $1,014 per light. We showed in our first letter that the average annual expense of the French lights was but $480 per light; to this statement and comparison Mr. Pleasonton makes no reply whatever. We admitted the great difficulty of comparison with English lights in consequence of numerous charges for charities, pensions, &c., the total number of pensioners on the Trinity House Establishment alone in 1834 being $431. And Mons. Fresnel, who made certain deductions to make comparisons with the cost of French lights, states the cost of the English at not over twice that of the French, or $960 per light. The absolute cost of a light is but of little importance. The underwriters of New York paid for the loss of the ship America, lost on the Tortugas, principally by reason of a bad light, $350,000.
See the evidence of Captain Samuel McPherson, inspector of American Insurance Company, paper F, and extracts from Captain Aikin's letter, the captain of the ship America, F F, and Captain Hillman's letter.

We are informed by the Superintendent, as a reason for the great and rapid decay of light-ships, that "as these vessels, when at their stations, always lie with their bows to the wind, it is impossible to air the hold sufficiently to prevent dry rot in the timbers."

The use of the common wind sail, known to all seamen, will secure a constant current of fresh air to any part of any vessel; and if this is the only cause of the rapid decay which he asserts has taken place, a more striking instance of the insufficiency of the system could not be adduced.

It is rather to illustrate a statement made by us in our first letter, that the apparatus used in our light-houses were constructed of bad materials and in ignorance of scientific principles, that we notice an assertion made by Mr. Lewis, that the use of plate glass "would add to the magnitude of the light." That is, in other words, plate glass is a magnifier—a new discovery in optics. It is certain that the distance at which a light may be seen does not depend so much on the size of the flame or light as upon its brilliancy. The solar ray of light from the mirror of the heliotropes, now used on the survey of the coast, the mirrors being about four square inches, has been seen 51,591 metres, or 27 geographical miles; and the Drummond light, from a lime ball but 3/8 of an inch in diameter, has been seen 70 miles off; and we have a familiar illustration in the star Sirius, with no diameter appreciable to the nicest instruments of modern science—it shines with much greater brilliancy than most of the planets infinitely nearer, and whose magnitudes are well known.

We refer to paper marked H, respecting Mr. Winslow Lewis's "patent" parabolic reflectors and "patent" lamps, of which he claims to be the inventor. The reflectors are much smaller than those used in Great Britain; ours being but 14 inches in diameter for the largest; those in Great Britain of the largest size are 25 inches in diameter, and the smallest 21 inches; while ours are altogether an inferior instrument, and manufactured at a trifling cost, as we are informed, of not over $10 each. The larger reflector and lamp attached, costs in England £49 sterling, or $215 each, and the smaller $180 each. The great cost arises principally from their being lined with a thick sheet of silver, of a highly polished surface. They are not of "various figures," as Collector Osborne states are those at Montauk light, but of uniform figure, with proper adjustments for focal distance.

To the assertion of Mr. Pleasonton's, that the end and intent of all our charges is to produce a change in the present management, in order to transfer it to a board of three Navy captains, we make an unqualified denial; we feel no interest in this particular, and care not under whose management, or under what department this important establishment may be conducted, so it be well managed, and the results produced which the seaman and merchant, and indeed the whole country, have a right to demand; we indeed think the management of our light-houses, for obvious reasons, should always be in the Treasury Department. Our
suggestion in respect to captains in the Navy was, that certain examinations and reports should be made by them of the good or ill management of our light-houses, and that from their character and position they would be far removed from any suspicion of influence from any quarter. It is quite evident there is an impropriety in depending on any contractor of supplies of any kind for this examination.

Under the present or past organization of the Board of Navy Commissioners, we believe the country would not be satisfied that this establishment should be placed under their control.

We indeed believe that every essential object would be attained by placing the details of the building and management of our light-houses in the Engineer's Department, subject to the control of the Secretary of the Treasury, and that a certain inspection and report by naval captains would be all that is necessary.

Whatever disposition may be made of this inquiry, whether the system as it is now administered will be suffered to go on, or whether such a supervision as the interests of commerce and the lives of seamen require will be for the future obtained, we have discharged our duty in calling the subject to your attention.

Although we have for a long time been aware that our light-house establishment was badly managed, and that in comparing ours with those of Great Britain and France, the time could not much longer be delayed when the whole subject would be forced on your notice and the proper remedy applied; yet we expected no opposition on the part of the Superintendent of Lights; we believed that it was but necessary to show him we were behind other nations, for himself to commence an improvement. Instead of this we find him making common cause with a contractor, and claiming, in the face of all evidence, that his establishment needs no improvement, and that he has kept the whole in a condition of which he feels proud. He bases the whole defence of his administration on the statement of an individual vitally interested in the continuance of the present state of things, and on statements impossible to be correct.

We have no pecuniary interest in this discussion. We are neither contractors nor expectants. As publishers of nautical works, and nearly connected with nautical men, we feel an interest in everything that belongs to their profession. Congress has liberally made every appropriation asked for, and no pains nor expense should be spared to make our light-houses as perfect as possible; for on the certainty of seeing them at sufficient distances often depend many lives and great amounts of property. The mere question of saving money in the building and management of light-houses, seems to be mistaken for economy; the value of one ship and cargo—for instance, the ship America, lost on the Tortugas—was greater than the annual cost of the maintenance of all our light-houses and light-ships.

If in this important inquiry we have proved, as we believe we must have done, that the assertion we first made, that our light-house establishment, and the general superintendence of it, and its whole management, are inferior to the establishments of Great Britain and France, and need a thorough reform, we believe that we shall already have been instrumental in commencing a new and more complete arrangement.
We think that the statements first made by us are fully borne out by the evidence brought forward; and that the whole system needs revision, a strict superintendence, and a different plan of operations, none will, we believe, deny; what that plan ought to be, is for the wisdom of Congress to decide.

E. & G. W. BLUNT.

IN SENATE OF THE UNITED STATES.

MAY 10, 1838.—Submitted, and ordered to be printed.

Mr. Davis submitted the following report:

IN SENATE OF THE UNITED STATES, March 22, 1838.

On motion by Mr. Davis,

Resolved, That the Committee on Commerce be instructed to inquire into the expediency of importing one or more sets of the most approved apparatus now employed on the coast of Europe in the light-houses.

Resolved, That the same committee be instructed to inquire whether a more efficient, safe, and useful system of locating, constructing, lighting, and managing the light-houses necessary for our coasts may not be adopted.

Attest: ASBURY DICKINS, Secretary.

The Committee on Commerce have, pursuant to the instructions of the Senate, had under consideration the expediency of introducing the dioptric apparatus for illuminating light-houses; and also, the expediency of improving the present organization of the system, and submit the following report:

At the last regular session of Congress provision was made, by a bill in the House of Representatives, for a large number of new light-houses upon the Atlantic and lake coasts. When that bill reached the Committee on Commerce of the Senate, they proposed to amend it by adding a section, which required the Board of Navy Commissioners, before any house should be erected, to cause each site to be examined, and the facts inquired into; and where no obligation should be found to exist against the proposed light, the erection of the building should go on; otherwise, it was to be suspended, and the facts reported to Congress; which amendment became a part of the law, and the surveys were accordingly made. By the report of the Navy Board, it appears that they have arrested the erection of no less than thirty-one of these proposed houses, for reasons which are assigned by the officers employed in that service, which seem fully to justify the following remarks in the concluding part of the report: "When the great importance in the light-house system is considered, in relation to the safety of human life and of vast amounts of property, to the facilities and rapidity of com-
munication which it gives between different parts of our extensive Atlantic and lake coast, and to the cost of establishing and supporting it, the board would respectfully suggest whether some additional measures may not be desirable for obtaining the necessary information to secure the greatest public advantages from the expenditures which may hereafter be authorized for these purposes"

The committee fully concur with the Navy Board, that legislation should proceed upon more safe and satisfactory information. Hitherto, Congress has had before it, when proceeding to authorize the erection of new houses, little information beyond the loose, irresponsible statements of petitioners; most, and perhaps all, of whom were, in many instances, unknown; and there is too much reason for believing that those most active in getting up these petitions have been persons interested in their success, that some importance might be given to an unfrequented harbor where they had lands; that they might be made superintendents of the lights, or make sale of the sites, or get a contract, or be benefitted in some other way which had no connection with the public interest beyond making it subservient to their own. It is time to adopt a course less liable to imposition, and better suited to the importance of maintaining an efficient, useful system of lighting our maritime and lake frontiers. In proportion as the approaches to the coast are perilous, so do the rates of freight and insurance increase, and these are charges upon merchandise which are ultimately borne by the consumer. So, also, are freights higher or lower in proportion to the duration of the voyage. If, therefore, in our interior waters, consisting of the great bays and sounds along the coasts which are filled with coasters and steamers, we keep up lights so that vessels can run in the night, the charges for freight are diminished, and the loss of time in travelling is greatly lessened, and the consumers are again benefitted, for all charges on trade fall on them. In whatever aspect these facilities which give despatch to commerce and navigation are viewed, the great ultimate advantages result to the public. It is, therefore, a high duty in Congress to watch over these improvements, and prevent their being perverted to individual and selfish purposes, and to make them as complete in their character as any reasonable expenditure of public money and the state of science will permit.

In order to place this matter fairly and fully before the Senate, the committee will give a brief account of our own system and that of France, which is believed to be as perfect as that of any European State, and then the difference, both in the mode of illumination and of conducting the systems, will be apparent, and we shall be able to judge how far their experience may be turned to useful account.

The law has hitherto confined the care of light-houses, floating-lights, beacon-lights, &c., of which we now have 238, chiefly to the discretion of the Secretary of the Treasury. It has been usual to add considerably to the number, by law, at every successive session of Congress, and the annual expense of maintaining them for the year preceding the 1st of July last, was $208,072. The system has, therefore, increased under an irregular course of legislation, accommodating itself gradually to the growth of the country, till it has become in all respects highly important.
The collectors of the customs, to the number of forty-four, have, by the appointment of the Secretary, (for which there is no legal provision,) the general superintendence, each within a district assigned to him, for which compensation of two and a half per cent. on his disbursements is allowed, not to exceed $400 to each annually. The keeper assigned to each house or boat derives his authority from the same source.

The houses are generally of stone or brick, and since 1812 have been illuminated by argand lamps, varying in number from four to twenty-one; the intensity of the light being greatly increased by the parabolic reflectors of Mr. Lewis, to whom the country is indebted for considerable improvements upon the means before employed in lighting the houses.

There is much reason for believing, however, that while our system (if system it can be called) has, probably, most of the time, been conducted with reasonable care and satisfaction to the public, in most respects, that both the French and English have, by scientific research and improvement, perfected theirs to a considerably higher degree.

The French have taken the lead, and are chiefly indebted to the high attainments and spirited zeal of Mr. Fresnel, who brought into successful practical use the lenticular apparatus, instead of reflectors. This apparatus is called dioptric, while that of reflectors is denominated cat-optric; and where both are combined, as occurs in some instances, it is distinguished as dia-cat-optric.

Of the dioptric lights the French have four classes, which indicate the power or intensity of light. The lenses are arranged in an annular form, and an argand burner, with four concentric wicks, is placed in the centre for the first class. The second has a burner of three concentric wicks, and so on. They appear to be rapidly superseding the reflectors in France, under the conviction that they afford a more brilliant, equal, and economical light.

The general supervision of light-houses, &c., devolves on the Minister of the Interior; but no new light can be established without the concurrent opinion of this Minister and the Minister of Marine.

Subordinate is a Commission des Phares; the members of which, except the secretary, receive no compensation. It has hitherto consisted of certain civil engineers, employed in the administration of roads and bridges, naval officers, and astronomers, with the late distinguished M. Fresnel as secretary and chief engineer. The design of such a combination is manifestly to bring to the public service the requisite qualifications to select the best sites, to construct the most suitable buildings, and to bring into use the most perfect and scientific apparatus.

The plans for buildings, except in the matter of fitness for lights, are submitted to the general council for the administration of roads and bridges; while all important improvements in lights are submitted to the whole board. The secretary and chief engineer manages the details, and keeps a constant and vigilant eye over the whole. The organization appears to be highly judicious, and the system is, as the committee believe, conducted with great success.

In proof of this, they will bring to view the opinions of several enlightened individuals.

In 1835, Mr. Stevenson, who is understood to be the general super-
intendnt of Scotch lights, was authorized by the commissioners of
northern lights, to examine the French dioptric lights. He states in
his report, that he visited many of them, to which he had unrestrained
access; saw them in full operation; and was made acquainted with the
apparatus by Mr. Fresnel, who answered all his inquiries with the most
liberal frankness, and instructed the keepers to do the same.

Upon a full examination under such favorable circumstances, and a
free inspection of the manufacture of the apparatus, the result was
decidedly favorable to the lenticular plan, because of its power, its
admirable diffusion of light, and its economy.

He affirms that any given quantity of oil will give out at least three
times as much light with the lenticular apparatus, as with the parabolic
reflectors, while it is diffused equally in a plane around the whole hori-
zon, which is a most desirable arrangement, and has never been attained
with the reflectors. After going through the details of estimating the
annual expense of dioptric and catoptric lights, he uses the following
language: "Thus it appears that the annual expenditure of the diop-
tric fixed light is £88 3s. 8d. less than that of a fixed light composed
of twenty-six reflectors; and the light given out is three times more
powerful, while at the same time it is more equally diffused over the
horizon."

Afterwards, a committee of the Royal Society, appointed to coope-
rate with the commissioners of northern lights, met in October, 1836,
to examine the new dioptric light on the Isle of May, and to compare
it with the old catoptric light near it. The observations were made at
a distance of thirteen miles, and the committee report that the follow-
ing conclusions seem to be warranted:

"1st. That at a distance of thirteen miles, the mean effect of the new
light is very much superior to the old light, (perhaps in the ratio of two
to one.)"

"2. That at all distances the new light has a prodigious superiority
to the old one, from the equality of its effects in all azimuths.

"3d. That the new light fulfils rigorously the conditions required for
the distribution of light to the greatest advantage.

"4th. That at distances much exceeding thirteen miles, the new light
must still be a very effective one, though to what extent the committee
have not observed. The light is understood to be still a good one when
seen from Edinburgh, a distance of about thirty miles."

The learned and distinguished Dr. Brewster, after examining the
subject fully, holds this language: "hence it follows that the lens appa-
ratus is in every respect better and more economical than the reflector
apparatus;" and again, "the lens apparatus is far more intense than
the reflector apparatus of the same size; with the same intensity of
light, it consumes much less oil; in reference to original cost, repairs,
and renewals, it is more economical; it requires a less expensive light-
room, and demands much less time and trouble from the keeper, while
it possesses the property (which reflectors never can have) of admitting
every variety of resource in cases which demand extraordinary illumi-
nations."

The committee find at page 72, Senate document, 138, present ses-
sion, an extract from a French document, which has in it the following language: "From numerous experiments made comparatively on several apparatus of the old and new system, it is satisfactorily demonstrated that a given quantity of oil employed in the illumination of light-houses (lenticular) gives from three to four times more useful light, that is transmitted horizontally, than if this same quantity of oil was consumed for illumination of the best apparatus with reflectors."

The committee might add much more concurrent testimony from equally reputable sources, tending to prove the superiority of the French system; but being satisfied with this, they forbear enlarging on this head, and will now consider what is necessary to constitute an effective system.

1st. The sites for light-houses and light-boats should be selected with great care and judgment, for the illuminated point should be that which earliest and most certainly indicates the danger to be avoided, and affords the safest guide along the channel. Nautical and hydrographical knowledge is obviously essential to a successful discharge of this duty. There is much reason for believing that many errors have been committed in the United States by the selection of improper sites; and it is said that some lights have been extinguished for this reason.

2d. The houses should be made of incombustible materials, and of such elevation above the level of the water as to be seen far enough to admonish the navigator before he falls into peril. They should be of a form adapted to the apparatus to be employed for illumination.

3d. The kind of light should be such as to enable navigators to identify it at first sight from all others. This is of first importance, as any mistake in the recognition of a light is quite as likely to end in disaster as safety. The committee have heard complaints on this head, that our lights are in some places either too numerous, or not so distinctly characterized as to be readily distinguished from each other. It is well known, that at several points on the coast, no less than five or six, or perhaps even more, may be seen by a vessel at the same time; and though, doubtless, they are generally readily known by those to whom they are familiar, yet others have found themselves embarrassed.

In the description given by the French government of their light-houses in 1837, the committee find the following account of their means of discrimination: "The fires of the light-houses and watch-lights may be arranged according to their distinctive characters in three principal classes, namely: fixed lights, eclipsing or revolving lights, or those which alternately appear and disappear, lights varied by great brightness, preceded and followed by short eclipses.

"1st. The fixed lights differ only in their greater or less intensity, with the exception, however, of the little red light on the northeast stockade of the port of Boulogne.

"2d. The eclipsing lights, called also revolving lights, offer no very marked differences except in the duration of their phases. They are produced regularly, at intervals which vary from half a minute to two minutes and three quarters.

"The bright light or flashes, (eclats,) which alternate with eclipses in
the lights of this kind, acquire, at the end of some seconds, their maximum of intensity, and decrease afterwards by the same gradations.

"When we are sufficiently near a revolving light, its eclipses no longer appear to be total, as we perceive, in the interval between the flashes, a light of much less intensity.

"3d. The lights varied by great brightness belong exclusively to a particular kind of lenticular light-houses. The longest period of the appearance of the light of this apparatus, presents a flash more or less brilliant, which, after a certain interval of time, gradually grows weaker. To this decrease of light (which, to the observer, placed at a sufficient distance, becomes a total eclipse,) succeeds, during some seconds, a bright light, much superior to the first. This great bright light afterwards decreases, and the fixed light reappears.

"The changes in the appearance of the light take place regularly, at intervals which vary from two to four minutes, according to the disposition of the apparatus."

From this and other statements, the committee infer that the French avoid the use of colored lights, because white lights are supposed, in a fog, to appear so discolored as to mislead the navigator, and to rely wholly on white lights, which are fixed or revolve, and are eclipsed, or send out flashes at regular intervals, some longer and some shorter, but each having a length of interval different from all others; and, therefore, is identified by the time, as well as the brightness or feebleness of the flash, according to the power of the light. The committee have heard of no practical inconvenience from this arrangement, though it is obviously less distinctive and marked in its character than colors.

On this point Mr. Stevenson remarks, that "as the sole object in establishing a light is to make known to the benighted mariner the land he has made, with as much certainty as the sight of a hill or tower would show him his position during the day, it becomes an object of the first importance to impress upon each light a distinctive character, which shall effectually prevent the possibility of its being mistaken for another."

The leading characteristic distinction in the Scotch lights is color. They employ, in all, six classes, namely: Fixed, revolving white, revolving red and white, flashing, intermittent, and leading lights; alleging that in practice they meet with no inconvenience or perplexity in the employment of colors.

The committee have been thus minute on this head, because it is obvious that, however perfect lights may be, they can be of little practical utility unless readily identified; and it is equally plain that those which assimilate in character or appearance should be placed as remote from each other as possible.

4th. The power of lights should be proportionable to the distance at which they ought to be visible, to give early notice to the navigator. Those first seen, in approaching the coast, should usually be of the first class, as they constitute the outer range, and are sea lights. Those upon the close waters may be of sizes proportioned to the object to be attained, as they serve as guides into harbors and along our bays, sounds, and inlets, through which our vast coasting trade passes. These waters, like great streets, may be so lighted that vessels of all classes may pur-
sue their voyages by night as well as by day. Indeed, those most frequented are now so lighted that steamers and coasters run with safety by night; and thus the traveller is expedited, and the duration of voyages lessened.

5th. The oil should be of the first quality; and we cannot too vigilantly guard against the introduction of inferior qualities, for with such, it will be in vain to hope for intense light from the best apparatus. The French use vegetable, while we use sperm, oil.

6th. The keepers should be persons of untiring fidelity and vigilance, as on the prompt and faithful execution of their duties depends the lives and property of their fellow-citizens. They should have a perfect knowledge of the apparatus, and all the most approved methods of keeping it in the most effective order. These are very important considerations, for, if cleanliness be neglected, or it be suffered to get out of order, ordinarily the intensity of the light is impaired, and consequently its usefulness.

7th. The lights should be frequently visited by a general inspector who is master of the whole subject, being fully capable of estimating the true character of the apparatus, its condition, the manner in which it is managed, whether the keepers are capable and faithful, and whether the oil is such as it should be. In a word, this visitor should be so thoroughly skilled in everything pertaining to the subject, as to keep the light-houses in as perfect a condition as the arts and the progress of science will allow. This great and important duty in France has hitherto, it is understood, devolved upon the secretary and chief engineer of the Commission des Phares; and to the late Mr. Fresnel, who filled that office, we owe a debt of lasting gratitude, as a common benefactor. We have already said certain collectors of the customs are the inspectors of the light-houses within their respective districts. It is manifest the two offices have no natural connection, for they require qualifications quite dissimilar. The one should understand the laws of light, as it is affected by reflectors and refractors; the other, the character and value of merchandise. And there is no affinity between the employments; nor does it follow that one who is well qualified for a collectorship has a particle of that information which is essential to a well-conducted system of lights. Again, the number is great; this duty is merely collateral; their visits are seldom; their attention little engaged in the matter. They have no control over the system, have no knowledge beyond their districts, and the consequence is, that their inspection is generally of little importance, and has little tendency to expose the faults or improve the character of the system. Indeed, so necessary is some other inspection, that the contractors who furnish oil are required to view and report upon the condition of each light, and so also are the immediate keepers. The subject was early committed to the supervision of the collectors, as a matter of convenience; but we may well inquire now, whether its importance does not call for a more skilful supervisor; one that can give harmony and character to the whole system, and make it not only keep pace with the progress of population and business, but with the advancements of mechanical and scientific improvements.

Such are the general outlines of what the committee consider essential to an effective system of light-houses, light-boats, beacon-lights, &c., and
it will be perceived from the course of remark, that the committee believe ours may be improved both in lights and in organization.

The committee are disposed, however, to attribute these results more to improvident legislation, and the want of suitable legal provisions, than to any other cause; but they believe that this is as favorable a moment as any which will occur to begin reformation. The great lake coast is pressing heavily for improvements, as well as the southern Atlantic coast, which greatly needs more and better lights. The track from our commercial cities to the mouth of the Mississippi has become a vast highway, bearing upon its intricate channel, which is beset with storms and currents, a trade of great magnitude, which is destined to go on increasing. It is a matter of high importance that light should be scattered along this track, and that the perils of navigation should be lessened by all suitable measures within our power. New light-houses have been and will continue to be demanded in this direction, and they ought to be of the most improved kind.

The committee are satisfied from the evidence before them, derived as it is from the most authentic and respectable sources, that the lenticular apparatus is the best in use; but, to test the matter, and place the truth or falsity of the statements beyond all doubt, they recommend an appropriation sufficient to import two sets of the first class of apparatus, to be placed at two of the most important points on the coast, where navigators may at once decide upon their character as compared with the old lights; and, also, one apparatus of the second class, to be put up at some point also to try its merits.

The committee would further recommend as a preparatory step to a better organization of the whole system, that the coast be divided into such districts as the President may deem convenient for the purpose, and that a sufficient number of naval officers be detached to survey and examine the light-houses, light-boats, beacon-lights, buoys, &c., and to report upon their present condition and usefulness, and also what improvements in their judgment the public emergencies demand. It is desirable, if convenient, that two officers at least should be assigned to each district; and that each board, after having made the survey and examination, shall also suggest modifications in the future organization of the light-house system, if in their opinion any change is expedient.

To carry into effect these measures, the committee request their chairman to move the subjoined as an amendment to some appropriation bill making provision for objects that harmonize in their general character with this

AMENDMENT

Fifteen thousand dollars, to enable the Secretary of the Treasury to import two sets of dioptric, or the most improved lenticular, apparatus of the first class, for light-houses, and one set of the second class; and to place them in light-houses where their value, as compared with the apparatus now in use, may be most speedily and effectually tested by the observation of navigators. And, to the end that Congress may be furnished with more exact information in regard to light-houses and the
light-house system, the President shall appoint such a number of naval officers as, in his judgment, is necessary to survey and examine the Atlantic and lake coasts, whose duty it shall be to report upon the present condition and usefulness of the light-houses, light-boats, beacon-lights, buoys, &c., designating such further and additional works and improvements as the public emergency most urgently demands; and, also, whether the public interest demands any, and, if any, what, modification of the system to render it more effective and useful; and the President shall, if he sees fit, divide the coast into districts, assigning such officer or officers to each district as he thinks proper, always assigning two to each district if the public service will allow of it, and each board shall report as above provided.

The subjoined letter from the Fifth Auditor of the Treasury, though promptly furnished, did not reach the committee until this report was drawn up. They, however, annex it with pleasure, as it is derived from an authentic source, but they find nothing in it which renders any modification of the report necessary:

**Treasury Department,**

*Fifth Auditor's Office, May 3, 1838.*

*Sir:* I had the honor, this morning, to receive your note of the 30th ultimo, requesting me to state, for the information of the Committee on Commerce of the Senate, what has been the system of erecting, managing, and illuminating our light-houses, and what the organization now is.

It is with great pleasure I proceed to give the committee the information desired.

The first act passed in relation to the light-houses of the United States, after the adoption of the Constitution, appears to be that of the 7th August, 1789, which assumed the expense of all those existing in the United States at the time, upon condition that the several States in which they were situated ceded them, with jurisdiction, to the United States by a given day; and that act charged the superintendence and management of them thenceforth upon the Secretary of the Treasury. On the 8th May, 1792, however, the office of Commissioner of the Revenue was established, and the superintendence and management of the light-houses, &c., were assigned to him by the Secretary of the Treasury.

The office of commissioner being abolished on the 6th April, 1802, the Secretary of the Treasury, Mr. Gallatin, resumed the superintendence of the light-house establishment, in whose hands it continued until the re-establishment of the office of Commissioner of the Revenue on the 24th of July, 1813. From this period, this officer was charged with the superintendence of the establishment until the 1st July, 1820, when the office was a second time abolished, under a law of 23d December, 1817, in relation to the internal revenue, and all the duties appertaining to the office, including those of superintending and managing the light-house establishment, were assigned to me by the Secretary of the Treasury. It then consisted of 55 light-houses and a few buoys; it now consists of 210 light-houses and 28 light-ships, with numerous buoys, monuments, &c.

The Secretary of the Treasury, as well as the two Commissioners of the Revenue, erected such light-houses as were authorized, by contract,
first advertising for proposals, and giving the contract to the lowest bidder. A collector of the customs was designated as superintendent, both in regard to building and repairing light-houses, within a particular district, and, as a compensation, he was allowed two and a half per cent. on his disbursements. He inspected the buildings after they were finished, or sent a person for that purpose, and did not employ an overseer of the work, day by day, as I have caused to be done in all cases of buildings since 1820.

Down to the year 1812, oil was provided annually by the Treasury, kept in stores, and sent, to the light-houses by the collectors as it was wanted. Spider lamps were employed in the light-houses, which consumed a vast quantity of oil without affording much light. The waste of oil by this mode of using it, with that by leakage at the custom-houses, was so great, added to the dimness of the lights, as to induce Mr. Winslow Lewis to turn his attention to the subject, with a view to producing economy, and, at the same time, a better light. His patent lamp and reflector was the result. On perfecting them, he proposed to Congress to sell to the United States the patent right, which he had obtained, for the saving of oil of one year, as used in the old mode. A law was accordingly passed in 1812, and a contract entered into with him by Mr. Gallatin, Secretary of the Treasury, for fitting up all the light-houses with his lamp and reflector, the saving from which, it appears, was 24,000 gallons of oil in one year, the consumption by the old mode being 48,000 gallons in about 49 light-houses then built. The light-houses being thus fitted up, Mr. Lewis proposed to receive a certain quantity of oil annually, with a specific sum of money for transporting it to the light-houses, and for supplying wicks, tube glasses, &c., and to oblige himself to keep them all lit, and the apparatus in good repair. To this the Secretary of the Treasury assented. Mr. Lewis, in this manner, kept the light-houses lit until they were transferred to me.

Since I took charge of the establishment, collectors have been designated, as formerly, to act as superintendents, allowing them two and a half per cent. on their disbursements, not to exceed $400 per annum. There are in all 44, a few of whom receive the limit, but in a great majority of cases they do not receive a compensation of $100 for this service. Notwithstanding the smallness of the compensation, they perform this duty satisfactorily. When a light-house is to be built within the district of any one of them, he is ordered to select the proper site, is furnished with a plan of the building by this office, and is directed to employ a suitable mechanic to see that the materials are good, and the work well done. On the certificate of the overseer to this effect, payment is made, but not otherwise. The superintendent is required, also, to make at least one visit a year (in June, when it can be done) to each of the light-houses in his district, and to report to me the condition of each. If repairs are required, they are ordered, and there is sufficient time, after June, to make them in each year. On this duty, the expenses only of the superintendent are paid. In this manner new buildings are well and substantially made, and the old promptly and effectually repaired.

Finding that the mode of lighting the light-houses adopted by Mr.
Gallatin, of supplying a certain quantity of oil and money, to Mr. Lewis, without advertising for proposals, was liable to objection, I determined to advertise for proposals to supply all the necessary oil, of the best quality, wicks, tube glass, buff skins, &c., and to keep all the apparatus in complete repair, for a given sum of money per lamp per year; the contract to continue in force for a period of five years.

It was required, also, of the contractors to visit all the light-houses annually, and report their condition to me. They were particularly to specify all the repairs which were required, to report the state of the apparatus, and the conduct of the keepers. A power was reserved in this office, in case this duty was neglected, of revoking the contract. In this manner I have made contracts, from time to time, with persons to keep the light-houses lit up, of the last of which I herewith enclose a printed copy. By this it will be perceived that the sum paid is $35 87 per lamp per annum, for supplying every thing necessary for lighting.

The keepers are, on their part, at the close of each year, to report the quantity of oil and other things received from the contractors during the year, the quantity and kind on hand, and the state and condition of the apparatus. If the oil is not good, or the apparatus is out of repair, they are instructed to report the same to the proper superintendent, who requires good oil to be supplied, and the apparatus to be repaired.

One inconvenience and injury to the service I have experienced, from our present mode of fitting up new light-houses, by giving the contract to the lowest bidder. In building light-houses, we are bound by law to advertise for proposals to fit them up, according to Winslow Lewis's patent lamp and reflector; but, as many of the persons bid, and some of them get the contract, who have never seen Winslow Lewis's reflector, they put up reflectors of a different kind, which is not discovered, probably, for some years afterwards. The consequence is, that, instead of getting reflectors which will show a light 20 to 25 miles, we get those which can be seen 10 or 12 miles only. To remedy this evil, I would respectfully suggest the propriety of authorizing this office, by law, to contract with the patentee for fitting up all light-houses which may be hereafter built, with his lamp and reflector, if he will engage to do it on reasonable terms. In case he will not undertake the service, on terms deemed reasonable, then the office shall advertise for proposals, and give the contract to the lowest bidder; the lamp and reflector to be subjected to the inspection and approval of the patentee, in every case.

I consider the present arrangement for managing the light-house establishment of the United States the most simple and the most economical that can be devised, and, at the same time, sufficiently effectual. But it is now a mere Treasury arrangement, and ought to be recognized and established by law. The collectors are designated to act as superintendents, without any authority of law, and might refuse to execute the duty if a control was not held over them by means of their collectors' offices. They should be bound by law, or at least such of them as may be designated by this office, in concurrence with that of the Secretary of the Treasury, to act as superintendents of lights, under the direction of this office, with a compensation to be fixed by law.

It is not known to the public who has the general superintendence of
the lighthouse establishment. It is generally believed to be in the hands of the Secretary of the Treasury, who has, in fact, but little to do with it. I would respectfully propose, therefore, that the name and the style of the office should hereafter be "The Auditor for the Department of State and General Superintendent of the Light-house Establishment." The powers and duties of the Auditor may remain as fixed by the law of the 3d March, 1817; but those of the lighthouse establishment ought to be in a general way, at least, defined by law.

The lighthouses are now all fitted up with the parabolic reflectors, by law. If any change be made, it must be by law. Should Congress think proper to make an appropriation of five or six thousand dollars, to procure a set of the French lenses, I will cause the utility of them to be tested, in comparison with the reflector, and report the result to Congress; after which they will act upon the subject as they shall think proper.

In my reply to the Blunts, of New York, I took some notice of the manner in which the lighthouse establishments of England and France were conducted. To that communication I respectfully refer the committee.

I have the honor to be, very respectfully, sir,

Your very obedient servant,

S. PLEASONTON,


Hon. JOHN DAVIS,

United States Senate.

Letter from the Secretary of the Navy, transmitting a copy of the report by Captains Kearney, Perry, and Sloat, of their examination of certain sites for lights, buoys, and beacons, in New Jersey.

April 12, 1838.—Referred to the Committee on Commerce, and ordered to be printed.

NAVY DEPARTMENT, April 11, 1838.

SIR: I enclose to you, agreeably to your desire, a copy of the report by Captains Kearney, Perry, and Sloat, of their examination of certain sites proposed for lights, buoys, and beacons, for New Jersey, and am,

With great respect, your obedient servant.

M. DICKERSON.

Hon. GARRET D. WALL,

United States Senate.

PERTH AMBOY, N. J., December 9, 1837.

SIR: We beg leave to transmit the report of our examination of certain sites specified in the communication we had the honor to make, (in reference to lights, buoys, and beacons.) bearing date the 20th of May last, proposed for New Jersey.
In referring to this subject, it is necessary to state a delay has occurred in consequence of one of the members of this board being absent on other duty, and we have been unable to comply with the wishes of those making the application (although having verbal permission so to do) until this late period.

The source from which it came being duly appreciated, we have given all the attention in our power to the subject to which our attention has been called, and, in this, we have received the aid of Commodore Ridgely, commanding the New York station, supplying vessels and men from his command. The duty has, therefore, been performed, in accordance with your directions, without expense.

After a careful examination of all the points specified, in relation to the objects required for the improvement and the safety of the navigation of the several bays and other waters of New Jersey, we are of opinion there exists a great want of proper facilities at each of them.

Raritan bay, Newark bay, and the sound, through which a valuable trade is carried on, are entirely without objects to facilitate their navigation.

Raritan bay is the route of not only steamers and small craft, but, also, of ships of draught. In the course of the past summer, from May until October, a period of only five months, twenty ships, four barks, and two brigs arrived in the port of Perth Amboy.

The whole tonnage enrolled and licensed in that district, on the 30th of September last, amounted to twenty-six thousand three hundred and fifty-eight, as will appear by a document herewith furnished, being an extract from the custom-house books.

It appears from the same statement that some of the ships were upwards of 870 tons, and of course very valuable. These fine ships were brought into Perth Amboy harbor, attended with great difficulty, owing to the want of proper buoys; ten of the number, getting out of the channel, got aground while under charge of New York pilots, who, ignorant probably of the channel, had no guides to assist them, there being no beacons or buoys, as before stated. These disasters, added to the circumstance of a double pilotage, charged by New York pilots, tend to produce a prejudice and a wish on the part of strangers to avoid ports in New Jersey. For these reasons, and for the better safety of our valuable inland trade, and the convenience of the number of steamers plying through the waters of New Jersey, we recommend a small beacon-light to be erected at South Amboy, the head of the above bay, contiguous to the South Amboy and Camden Railroad wharf, supplied with one large reflector and a convex glass, for the purpose of exhibiting its light at the same time to the lower bay and the entrance of the Raritan river and the sound, which light may be constructed in so simple a manner as to involve but little expense.

We beg leave to repeat the recommendation offered to the Navy Commissioners by us, in our report some time since, as to an alteration in the light at Prince's bay by adding to it another table. This suggestion is contained in an extract from our report, herewith furnished, and is submitted as a matter of importance at this time for your consideration.
The establishment of these two lights and five buoys suggested by us will render safe the navigation of this bay either by night or day.

After all these measures shall have been adopted, there are still great dangers to encounter in passing from Raritan bay to New York bay, through the passage over the west bank, by steamers and bay craft, known as the Swash.

There are two wrecks lying under water directly in the course of these vessels; one a schooner, in three fathoms water, with two hundred tons of coal on board; the other a sloop, in $2\frac{1}{2}$ fathoms, laden with lime; the former sunk last winter, the latter this fall. As these dangerous objects are abandoned by their owners, it is probable they will be suffered to remain where they are.

The pilots, at times, have no guide but the lead, and as the soundings about these wrecks differ so little from the general depth of the Swash channel, they occasion much difficulty and danger to navigation at night or in foggy weather.

Vessels bound for New York entering by way of Sandy Hook, are frequently carried through this swash, especially in winter season, by way of avoiding the ice drifting down the ship channel, and these wrecks must prove particularly dangerous at that time. It was but recently the steamer Independence, plying between South Amboy and New York, ran upon the wreck first mentioned, carrying away her wheel. Had her hull have struck, instead of her wheel, her loss would have been inevitable, with all her passengers, her valuable freight, and the United States mail. If such had been the melancholy case, it would have brought this subject into earlier notice.

We therefore, for reasons stated, recommend the immediate removal of these objects before the inland passage, by way of the sound, is closed by ice, and when the whole number of vessels employed will be obliged to take the outside passage, where these dangers exist.

The next object of our examination was in reference to similar facilities for the navigation of the sound, or Kill Van Kull, in which great inland trade is carried on.

We have been governed, both by a personal knowledge on our own part, and information received from others, in reference to this point, having sought it from experienced men of intelligence, upon whom we could depend; and in making up our opinion as to the necessity of the objects asked for, we are unanimous, and recommend the erection of a beacon-light at the Corner Stake, as it is called, being a sudden bed in the channel between Elizabethtown point and Shorter's island; also, another small light or lantern on Shorter's island. These two lights, in connection with the light directed to be built on Robbin's reef, will add greatly facility to the navigation of this part of the Kills.

A dangerous reef lies off Bergen point, and another, further east, called the Mill Rocks. On these reefs spar buoys would be serviceable; and we recommend one at the point of each.

The bay of Newark is navigable for vessels only of light draught of water, but as a great deal of trade is carried on through it by small vessels and steamers, and the navigation is very difficult, owing to the
mud flats and oyster beds that extend far out, and over which vessels cannot pass, we recommend the following buoys for this place, viz:

A spar buoy on the first oyster bed, or point of the bar, between the Hackensack and the Passaic channels, one and a half mile below the crossing place.

A spar buoy at the Corner Stake, so called by pilots.

A spar buoy at the crossing place on the north side.

A spar buoy at the Elbow, opposite to which, in the channel, is fifteen feet depth at high water.

The above buoys, together with one on Bergen reef, and the beacon-lighthouse at the Corner Stake in the sound, comprise all the objects which we deem necessary for Newark bay.

The water being shoal, the buoys may be much less in size than those for places more exposed. They will, however, require heavy weights to prevent their being moved by ice.

We respectfully beg leave to connect with the subject of this report another important subject, which had more properly appeared in a former report we had the honor to make, in relation to buoying out Gedney’s channel. The importance of this deep channel is now manifest; and all that has been said of it has been confirmed by the Ohio ship of the line, on her way to Boston, carrying out upwards of thirty feet water, when it appeared the tide had fallen a foot, making the greatest depth, common spring tide, 31 feet at high water. We therefore, recommend that a monument be erected on the front beach of Staten island, west of the great elm tree, as a leading mark, which, also, will be useful in respect to the other channels over Sandy Hook bar, affording different ranges in connection with different objects on the distant high land of Staten Island, as the case might require.

The position of it, therefore, is of much importance to the whole; and we recommend that the location be submitted to the judgment of Lieutenant Gedney, who has surveyed the waters in this quarter.

Very respectfully, your obedient servants,

LAWRENCE KEARNEY,
JOHN D. SLOAT,
M. C. PERRY;
Captains, U. S. Navy.

Hon. Mahlon Dickerson,
Secretary of the Navy.

The light-house at Prince’s bay, though remarkably well kept by its faithful and attentive keeper, (Mr. Rawson,) requires an essential improvement, which may be explained by the following extract from our report to the Navy Commissioners, bearing date July 17, of the present year:

"With respect to the other light-houses visited by us, we shall briefly remark, that they answer the purposes for which they were erected. But as a necessary improvement to the one at Prince’s bay, which appears to have been lighted for the convenience only of vessels bound
to and from New York, we would suggest the expediency of placing some additional reflectors to face to the westward, for the benefit of those navigating at night the upper part of Prince's and Raritan bays, a convenience the more important in winter, when the steamers and coasters, bound from ports in New Jersey to New York, are compelled, on account of ice in the Kills, to pass to the southward of Staten Island. The lantern of the light-houses is lighted with eleven reflectors, fixed upon a vertical table, permanently facing east-southeast, consequently, it only illuminates the horizon from north-northeast to south-southwest, the light being entirely obscured towards that part of the channel to Amboy, which is the most intricate. We therefore recommend that another table be attached to the present one, to face to the west-southwest, and that it be furnished with six reflectors, to be placed vertically in pairs.”

AN ACT making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys, for the year one thousand eight hundred and thirty-eight.

SEC. 2. And be it further enacted, That the Secretary of the Treasury be, and he hereby is, directed to cause two sets of dioptic or lenticular apparatus, one of the first, the other of the second class, and also one set, if he deems it expedient, of the reflector apparatus, all of the most improved kinds, to be imported, and to cause the said several sets to be set up, and their merits, as compared with the apparatus in use, to be tested by full and satisfactory experiments; and the sum of fifteen thousand dollars, out of any money in the Treasury not otherwise appropriated, is hereby appropriated for that purpose. And the Secretary of the Treasury is also further authorized to ascertain, by suitable and proper experiments, the merits of the apparatus lately invented by Mr. E. Blunt, of New York; and if, in his judgment, it has merits which justify the adoption of it, he is hereby authorized to contract with Mr. Blunt to light any light-house on the coast with it; and the sum of one thousand dollars is hereby appropriated for the above purposes. And the Secretary of the Treasury is hereby further authorized to ascertain the merits of the patent fog bell of Andrew Morse, jr., and, if he deems it expedient, to establish one on the coast, the sum of twenty-five hundred dollars is hereby appropriated for that purpose, out of any money not otherwise appropriated.

SEC. 3. And be it further enacted, That in order that Congress may be furnished with more exact information in regard to light-houses, the light-house system, the President is hereby authorized to divide the lake and Atlantic coasts into such districts as he may deem expedient; and he shall appoint a naval officer or officers, if the public service will allow of it, to survey and examine each district with reference to all the objects aforesaid; and it shall be their further duty to inspect all the light-houses, light-boats, buoys, beacons, &c., and to report upon their present condition and usefulness; also to inquire and report whether the
present public emergencies require any, and, if any, what further additional works and improvements of the above description, and of what kind; and also further to report whether, in their judgment, the public interest requires any modification of the system of erecting, superintending, and managing the light-houses, light-boats, &c., and, if so, in what particulars; and each board shall report separately on all these matters, which reports shall be laid before Congress.

SEC. 4. And be it further enacted, That the Secretary of the Treasury be, and hereby is, directed to instruct such officers to examine and determine whether it be expedient to construct light-houses or beacon-lights, and other works hereinafter described, at the following places, viz:

* * * * * * *

STATE OF MAINE.

SEC. 5 And be it further enacted, That in all cases where appropriations are made in this act for the erection of new light-houses or new light-boats to be established at places not before authorized by law, all such places shall first be carefully examined, and the most suitable site selected; and the persons making the surveys for proposed works in the last preceding section of this act shall report to the Secretary of the Treasury upon which of said sites, if any, the safety of navigation and the public interests require the work proposed for it; and also a plan and estimate in detail of the expense of each work so required, including the necessary buildings to be connected therewith. And it shall be the duty of said Secretary to communicate the reports thus made to Congress within the first week of the session thereof, in December next. And the expense of said surveys is hereby authorized to be paid by the Secretary of the Treasury out of any money in the Treasury not otherwise appropriated, the same having been first adjusted and allowed by the Secretary of the Treasury.

SEC. 6. And be it further enacted, That the Secretary of the Treasury be, and hereby is, authorized to discontinue, at his discretion, the old light-houses at Oswego, Dunkirk, and Cleveland, and cause the sites belonging to the United States of the old light-houses of Cleveland, on Lake Erie, and at Buffalo, in the State of New York, to be sold for such prices, respectively, as he shall deem the same to be worth, and the proceeds of such sales to be paid into the Treasury.

SEC. 7. And be it further enacted, That the sum of two thousand dollars be, and hereby is, appropriated, to enable the Secretary of the Treasury to employ two additional clerks in the Fifth Auditor’s office.

SEC. 8. And be it further enacted, That the sum of fifteen hundred dollars be, and is hereby, appropriated, to enable the Secretary of the Navy to cause such a special examination of the coast between the mouths of the Mississippi and Sabine rivers, and the intermediate harbors, bays, and bayous, as may be necessary to fix suitable locations for light-houses and other improvements, which may give a more safe and ready access to the said harbors, bays, bayous, and rivers.

Approved July 7, 1838.

JULY 7, 1838.—Ordered to be printed.

The subscribers, a committee appointed by the Chamber of Commerce at a regular meeting held on the 5th ultimo, to examine certain documents and reports made to the Senate of the United States relative to the mode of lighting, and of the general management of the light-houses and light-ships, &c., of the United States, beg leave to report:

That, from a careful examination of these reports, and from the evidence furnished by the testimonials of shipmasters, inspectors of insurance companies, and others well acquainted with the subject, they are satisfied that the mode of lighting and the general management of the light-house establishments of Great Britain and France are greatly superior to those of the United States.

That it also appears that various alterations, in changing fixed lights to revolving ones, and in altering the position of light-ships, have been made; that new light-houses also have been built and lighted, and, in some cases, no previous notice given, contrary to the practice of other maritime countries; and it is the opinion of your committee that many losses have taken place and ships frequently been endangered for the want of such notices.

That, in the opinion of your committee, it should be made imperative on the Superintendent of Lights to give through our consuls abroad, and by every practicable means in his power, as long previous notice as possible, when the erection of any new light-house or any change in the mode of lighting is determined on.

That the report made to the Senate of the United States is favorable to the adoption of a plan for the improvement of the present light-house system. In this report it is recommended that naval officers be appointed to make the necessary surveys and examinations, and to report what improvements, in their judgment, are necessary; and it also further recommends that two sets of lights of the most improved construction be imported and placed in such situations as that they may be compared most effectually with those now in use.

The committee, therefore, recommend the following:

Resolved, That, in the opinion of the Chamber of Commerce, some alteration in the mode of lighting and of managing the light-houses, light-ships, &c., of the United States is necessary; they approve of the report submitted to the Senate by the Committees on Commerce on this subject, and of the recommendations contained therein.

Resolved, That a copy of the above resolution be forwarded to the chairmen of the Committees on Commerce of both Houses.

ARCH. GRACIE.
HENRY W. HICKS.
MOSES GRINNELL.
SIR: In an act of Congress entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838," passed on the 7th July, 1838, are the following provisions, viz:

"SEC. 3. That, in order that Congress may be furnished with more exact information in regard to light-houses, (the light-house system,) the President is hereby authorized to divide the lake and Atlantic coasts into such districts as he may deem expedient. And he shall appoint a naval officer, or officers, if the public service will allow of it, to survey and examine each district, with reference to all the objects aforesaid; and it shall be their further duty to inspect all the light-houses, light-boats, buoys, beacons, &c., and to report upon their present condition and usefulness; also, to inquire and report whether the present public emergencies require any, and, if any, what further additional works and improvements of the above description, and of what kind; and, also, further to report whether, in their judgment, the public interest requires any modification of the system of erecting, superintending, and managing the light-houses, light-boats, &c., and, if so, in what particulars; and each board shall report, separately, on all these matters, which report shall be laid before Congress.

"SEC. 4. That the Secretary of the Treasury be, and hereby is, directed to intrust such officers to examine and determine whether it be expedient to construct light-houses or beacon-lights, and other works hereafter described."*

"SEC. 5. That in all cases where appropriations are made in this act for the erection of new light-houses or new light-boats, to be established at places not before authorized by law, all such places shall first be carefully examined, and the most suitable site selected; and the persons making the surveys for proposed works in the last preceding section [meaning the 3d section] of this act, shall report to the Secretary of the Treasury upon which of said sites, if any, the safety of navigation and the public interests require the work proposed for it; and also, a plan and estimate, in detail, of the expense of each work so required, including the necessary buildings to be connected therewith. And it shall be the duty of said Secretary to communicate the reports, thus made to Congress, within the first week of the session thereof, (in December next,) and the expense of said surveys is hereby authorized to be paid by the Secretary of the Treasury out of any money in the Treasury not otherwise appropriated, the same having been first adjusted and allowed by the Secretary of the Treasury."*

The President, under the 3d section of the act, has divided the Atlantic coast into six districts, and the lakes into two districts. To the first district you have been assigned, by the Navy Department; this extends from Eastport, in Maine, to Boston, in Massachusetts. The 3d section of the act sufficiently defines the duties you are required to perform.

* These are classed and extracted for each particular district; and are detailed in a subsequent part of this letter.
under it, within the district assigned you, and requires no remark from me.

The 4th section of the act refers to objects for which no appropriations have been made; and those of them falling within your district are as follows, viz:

* Light-house district No. 1, in the State of Maine. *

* In Massachusetts. *

The 5th section of the act refers to light-houses and light-boats, for which appropriations have been made, but which were not before established or authorized by law. None of these, however, are comprehended within your district.

It is to the objects referred to in the 4th section, therefore, that I have to call your attention. In regard to these, you will proceed, with as little delay as possible, to examine the local situation of each place indicated in the law, and decide, with the best lights you can obtain, whether the light-house or other object (as the case may be) is required for the purposes of commerce and navigation; and if you shall be of opinion that it is required, you will report accordingly to the Secretary of the Treasury, with the reasons on which your opinion is founded. Should your opinion be adverse to the proposed object, you will, in like manner, assign your reasons therefor. It may be well, in all cases of importance, to request the opinions, in writing, of retired pilots and shipmasters, (if there be any in the neighborhood of the place to be examined,) as to the necessity and degree of utility of the objects proposed; and to transmit them, with your own opinion, to the Treasury Department. When an object is recommended as proper, you will designate the most suitable site for it.

To facilitate the execution of your duties, in this instance, the collector at Portland will be instructed to place a cutter under your direction, if it can be spared from its appropriate duties. If a cutter cannot be spared, the collector at Portland will be authorized to charter a small vessel, upon the best terms he can, to convey you from place to place, as may be found necessary. He will also provide you with such stationery as may be necessary.

As the Secretary of the Treasury is required to communicate the reports you may make to Congress early in December next, you will be sensible of the importance of making the examinations and reports at as early a day as possible.

I have the honor to be, very respectfully, your obedient servant,

S. PLEASONTON.

Lieutenant Thomas J. Manning,
United States Navy.

Note.—Similar letters were written to each naval officer, adapted to their particular districts.
FIRST REPORT OF LIEUTENANT C. T. PLATT.

GENEVA, N. Y., October 30, 1838.

SIR: The report that I have the honor of transmitting, includes that part of my duty to which my first attention was directed in your instructions to me of the 4th August last. I have deemed it not improper to include in the report my observations respecting the location of a light at South Bass island. With respect to my further duty under the 3d section of the act of Congress respecting light-houses, &c., I will observe, that I have visited all the lights in the district to which I have been assigned, comprehending those situated on Lakes Erie, Ontario, and Champlain, with the river St. Lawrence, a report of which I shall endeavor to lay before you as soon as it can be properly arranged. From the advanced state of the season, I found myself unable to take the proper soundings on Lake Champlain for the location of buoys, &c. This is a duty that must be performed in an open boat, and the prevailing high winds at this season of the year render an accurate performance of that duty hazardous, and, I might add, next to impossible. With this view of the matter, it is my intention (unless otherwise ordered) to return to Lake Champlain, and complete the necessary duty during the approaching spring.

I have the honor of enclosing such letters from retired masters and pilots as I have been able to obtain, respecting the location of lights at the points referred to in the accompanying report.

I have the honor to be, respectfully, sir, your obedient servant,
CHARLES T. PLATT.
Lieut. U. S. Navy.

Hon. Levi Woodbury,
Secretary of the Treasury.

GENEVA, N. Y., October 30, 1838.

SIR: In pursuance of your instructions to me of the 4th August, I have the honor of laying before you the result of my examinations, with reference to the several points to which you called my first and particular attention; and to that end I commence with Bartlett's point, at the mouth of the bay formed by the entrance of French creek into the river St. Lawrence. I have, accordingly, made the necessary examinations and experiments with the most effectual lights that could be procured, and have marked a black-oak tree with the letters L H, on the site of which I would recommend a light upon the top of a suitable dwelling for the keeper. The importance of this light may be understood from the fact of its conspicuousness for 14 miles distance, on three different channels—the upper and lower American and the Kingston channels; the latter of which is the line of navigation which our steam-vessels universally follow. The danger ensuing, from the proximity of many hidden shoals, to the course pursued by navigators,

10 L H P
otherwise effectually rendering these channels perilous, is, by means of such a light, entirely obviated. The site selected is a commanding one, sixty feet above the surface of the water; add to this thirty feet, the proposed elevation of the lantern, and it places it ninety feet above the level of the river.

The commerce of this river is already great and rapidly increasing, and, in my judgment, the safety of navigation fully warrants the location of a light-house on the above-mentioned point. With this view of the matter, I respectfully submit the following plan and estimate:

The dwelling to be 25 by 30 feet, height to eaves 12, feet, extreme height $24\frac{1}{2}$ feet; to be partitioned on the first floor with an entry in the centre, 5 feet in width, leaving on one side a room 21 by $10\frac{1}{2}$ feet, on the other a room $10\frac{1}{2}$ by 12 feet, and a bed-room $10\frac{1}{2}$ by 9 feet. A larder will be so arranged as to occupy the space under the flight of stairs. Thus we have, on the first floor, a comfortable room, a kitchen, bedroom, and larder; and on the second floor, two arched rooms, ceiling $8\frac{1}{2}$ feet in height.

My attention is next called to the propriety of building a light-house on the pier at the mouth of the Genesee river, New York; and on that subject there can be but one opinion. It is unnecessary to expatiate upon the importance attached to the commerce of this harbor. The report already in the possession of the Department is deemed sufficient to justify large and liberal appropriations; suffice it to say, that a report at this time would not only corroborate the commercial importance, (so ably represented by Capt. Wm. Smith, of the engineer corps,) but would magnify the increasing commercial interest to an extent that would undoubtedly recommend to the Government the following appropriation for the building of a permanent light-house, on a solid and durable foundation. The site fixed on is at the extremity of the west pier. The following plan is respectfully submitted; a drawing of the same may be found with the Engineer Department, sent there by Capt. Smith, engineer; and having expressed my views respecting the location and style of building, and finding them to accord with a drawing that he had transmitted to the Department, I did not hesitate to assume his plan, and have made my estimate accordingly.

The first course of masonry, resting on a platform built on piles, will be begun at a little below low-water mark; and the succeeding courses of the foundation, four in number, will recede $\frac{1}{10}$ of a foot each; leaving the diameter of the top courses $12\frac{1}{4}$ feet, the upper surface of which will be on a level with the upper surface of the piers. As that forms the foundation proper of the light-house, and will be entirely hidden from view when the piers are completed, it may be built of rough stone masonry, larger stones being used on the outside than in the interior.

The vertical section through the face of the building is a regular curve. It is a portion of an ellipse, so assumed that the highest point of it is at the extremity of its conjugate diameter, and as the curve makes, in going from the bottom to the top, 6 feet, it is so regulated that
at one-fourth the distance from the bottom it runs in 4 feet, the remaining 2 feet being effected in the remaining height.

The outer face of the building is to be of cut stone, and the courses of masonry will diminish in height, in ascending, in the following manner, viz: the first course 2 feet high; the second and third courses 23 inches; the fourth, fifth, and sixth, 22 inches; and so on to the top. The breadth of the lowest course is three feet; and as the courses are to break regularly, the one over the other, that of the last course will be a little over 19 inches. The outside stone will extend into the wall between two and three feet, the other part of it being constructed of stone of an inferior quality. The object in assuming a curved instead of a plane surface for the outer face was to save masonry, as well as to combine beauty with strength.

On the south side there will be a door and two windows, and on the north one window; and as the first floor of the light-house is two feet above the level of the pier, there will be three steps on the outside to ascend to it. The stairs will be the common spiral stairway, the outer extremity of each stone resting on the one immediately below; thus forming, in the centre of the light-house, a regular column, and the other extremity inserted in the wall sufficiently far to give each step its proper degree of support.

The stairs will be carried up to within about six feet of the cornice, or rather to such a height as shall enable a person to stand erect without bringing his head in contact with the dome. At the top of the stairs a flooring will be thrown over about two-thirds of the whole area, and the remaining height will be ascended by means of a ladder.

The parapet-wall will be octagonal, four feet high and one foot thick, and the cupola will be partly formed and principally supported by eight strong iron pillars placed in the angles of the octagon. These pillars will be inserted in the light-house, and firmly connected with the parapet-wall. Each face of the octagon will contain eight panes of glass, and the cupola will be surmounted with a dome. The light itself will be about 60 feet above the surface of the water.

From the following estimate it appears that the expense of building such a light-house will be about eleven thousand dollars.

The question may now be asked, why a plan involving so much expense has been submitted, when a much cheaper one might answer as well; particularly when there is at the mouth of the river a light-house already erected.

If a mere beacon-light be built, it will be necessary, during the season of navigation, to keep two lights burning, as it cannot answer the purpose of a light-house. If a light-house be built, it will serve for both, and consequently save the expense of an additional light in oil and attendance. Although this is not a heavy item, if to it be added the expense of a beacon-light, of repairing the present light-house, and of ultimately rebuilding it, (which must be done at no very distant day,) it will at once be seen that building a good light-house now will in the end prove cheaper. To be convinced that the present light-house will need rebuilding, it is sufficient to know that the stone of which it is constructed is the same
kind of red sandstone that was found to be unsuitable for the piers, and that the workmanship of it is by no means the best.

The adoption of the plan proposed would require a greater immediate expenditure, but finally, without doubt, the Government would be the gainer. The necessity of establishing a permanent light-house at the extremity of the west pier, that will be accessible at all times, would seem to admit of no controversy; and for the attainment of that object I have the honor of submitting the following plan and estimate. The foundation has already been commenced, and is constructed in the following manner: Around the end of the west pier large cribs were sunk, enclosing a space of water 40 feet square; a crib 40 by 40 was then built and inserted within this space. This crib contained an interior space 30 feet square, which space has been filled up with piles and stone. The piles are a little over three feet apart, are driven between ten and fifteen feet into the sand, and are surrounded by the rough stone with which the interior space of the 40-feet crib is filled. The tops of the piles will be cut off level, and a platform placed on the top of them; the whole being a little below low-water mark. The weight which the foundation can sustain is 6,000,000 pounds—a weight more than double that of the light-house.

That the light-house may be reached in the worst kind of weather, the outside wall of the pier, together with the parapet, will be 9 feet high.

The time estimated by Captain Smith for the construction of the piers is four years, and their cost $190,000. The length of the west pier 2,669 feet; that of the east 2,633 feet; and their breadth 20 feet.

The Genesee river is navigable between four and five miles above its mouth, with a depth of 30 feet water. The width of the harbor is 450 feet, and the least depth of water between the piers is 12 feet.

My attention is next drawn to the survey of Maumee river, in the State of Ohio, to ascertain the necessity of establishing a beacon on a point near Delaware flats, (so called,) in the Maumee bay; also a beacon-light on the lower end of Big island, near the foot of the rapids of the Maumee river.

With respect to the location of a light on Big island, in the Maumee river, I have concluded, after a careful examination, both of the river and the island, that a light of any kind on that island is entirely unnecessary. The river is very narrow from Toledo, at a distance of seven miles, to the island; the banks are generally high, and the island is very conspicuous. A light placed upon this island could not, in consequence of the tortuous course of the river, be seen to a greater distance than one mile, and, therefore, its advantages in facilitating the navigation of the river would be lost.

Big island is situated in the middle of the river, with Perrysburg on the left (as you ascend the river) and Maumee on the right. There is a good channel on each side of the island, to conduct you to either of the above-named ports, which are themselves at the head of navigation, upon the river. The commerce of these ports is at present very limited, although their increased commercial importance may hereafter call on the Government for appropriations to effect the dredging and clearing
out of the channel, now affording but $7\frac{1}{2}$ feet of water. Such measures
are, in my opinion, of the first importance to the growth and wealth of
the above ports.

With respect to a light on Delaware flats (so called) in the Maumee bay,
I have determined, after examining and surveying the above place, that
the navigation of the Maumee bay does not require any additional lights.
I find myself sustained in this opinion by the concurrence of the most
skilful and experienced retired captains and pilots, as well as of masters
now navigating the lake. A vessel may be considered in safety as soon
as it arrives at Turtle island.

The light upon this island is situated directly in the mouth of the bay,
and so well is the channel understood to Toledo or Manhattan, after
passing this light, that steamers and other vessels are continually plying
through it during the night.

Stony point, Lake Erie, (in the State of Ohio,) comes next in order.
After having examined this point in all its bearings with reference to a
light-house, I have come to the decision that the safety of navigation will
in no manner be promoted by the erection of a light at this point. If,
indeed, by the establishment of this light any assistance would be afforded
to vessels in making a port of safety in foul weather, that would itself
be quite sufficient. On the contrary, there is nothing that makes it at
all necessary to locate a light on Stony point, which I think will appear
evident from the following bearings and distances of the respective lights
to each other, commencing at Buffalo and terminating at Gibraltar, 18
miles from Detroit:

From Buffalo to Silver creek, SW. $\frac{1}{2}$ S., 36 miles.
From Silver creek to Dunkirk, SW. $\frac{1}{2}$ W., 9 miles.
From Dunkirk to Barcelona, SW. $\frac{1}{2}$ W., 15 miles.
From Barcelona to Erie, SW. $\frac{1}{2}$ W., 30 miles.
From Erie to Conneaut, SW., 30 miles.
From Conneaut to Ashtabula, SW. by W., 15 miles.
From Ashtabula to Cunningham creek, SW. by W., 12 miles.
From Cunningham creek to Grand river, SW. by W., 18 miles.
From Grand river to Cleveland, SW., 30 miles.
From Cleveland to Black river, run 18 miles W.; 10 SW. by S. $\frac{1}{2}$ S.;
28 miles.
From Black river to Huron, SW., 22 miles.
From Huron to Sandusky, NW., 12 miles.
Port Clinton is 15 miles around a peninsula; first course, W. NW., 7
miles; next course, SW. 8 miles; 15 miles.
From Port Clinton to Turtle island, NW. by N., 20 miles.
From Turtle island to Otter creek, N., 7 miles. This light lies in the
lower part of the bay, and is not run to in a direct course for Detroit,
but is left west about 4 miles.
From Turtle island to Gibraltar, NE. $\frac{1}{2}$ N., 30 miles.
Thus, it will be perceived, we have a complete line of lights extend-
ing along the whole southern and western shores of the lake, and at a
suitable distance from each other. With these views of the subject, I
am decidedly of opinion that an additional light at Stony point is not
required.
Before closing this report, I must respectfully beg leave to submit my observations respecting the location of a light-house on South Bass island. I find an appropriation of $3,000 has been made for the construction of a light-house on Bass island, in Lake Erie, instead of one on Cunningham's island, as first purposed. This, to my surprise, was recommended to be placed on the northwest end of the island. It is my decided opinion that a light of some kind should be located on this island, as it is important that navigators of any kind of vessels, in their course to and from Detroit, the mouth of the Maumee river, or the river Raisin, should both see and recognize this island; but, both from my own observation and from the information I have received from some of the oldest and most experienced navigators of Lake Erie, I am decidedly of opinion that this light should be situated on the southwest cape of the South Bass point (so called) instead of where the law directs.

If a light be erected on the northwest point of said island, it will be upon the opposite side of the island, or rather upon a point of the island which is hidden entirely from the view of the navigator in his usual and shortest route to the upper points of the lake before mentioned, and would only be seen by the unfortunate navigator who was obliged, for shelter from the storm, to seek the lee of this island in a westerly gale; and then, even, I am of the opinion that a light on the southwestern cape would be of equal importance in assisting one to find that harbor, with one placed on the northwestern point of the island, or Gibraltar, (so called.)

So sure am I, sir, that my views of the matter would meet your approbation, that I have surveyed the southwestern cape of said island, and marked a tree with the letters L H, the spot on which, in my opinion, the light should be erected.

I have the honor to be, respectfully, sir, your obedient servant,

CHARLES T. PLATT,
Lieut., U. S. Navy, surveying and inspecting the second light-house district on the lakes.

Hon. LEVI WOODBURY,
Secretary of the Treasury.

SECOND REPORT OF LIEUTENANT C. T. PLATT.

GENEVA, N. Y., November 26, 1838.

SIR: I have the honor of laying before you the result of my duties, as far as completed, in the second lake district, comprising Lakes Erie, Ontario, and Champlain, and the river St. Lawrence.

In compliance with your instructions to me of the 4th August last, I proceeded to Erie, Pennsylvania, and there commenced the performance of my duties in the revenue-cutter commanded by Captain Daniel Dobbins, whose experience had afforded him a knowledge of Lake Erie, which, unlimited as it was, conjoined with the assistance of his officers, was importantly serviceable in facilitating the discharge of my duties.
Commencing with *Buffalo*, I found that the light-house was situated on the extreme outer end of the mole, and that it was a new building, in perfect order. The number of lamps is fifteen, stationary; the chimneys are too short, not extending above the scallops of the reflectors; the smoke consequently partially destroys the brilliancy of the reflectors, so important to the navigator; otherwise the materials furnished by the contractors are faultless. The dwelling, standing on the site of the old light-house, has been recently repaired and rendered comfortable. This light-house is well tended, and, as its location affords to the navigator a sure and safe guide to the only entrance to the harbor, is, for the present, fully adequate to the increasing commerce of this lake.

On approaching Buffalo, and observing the number of vessels of all sizes and descriptions constantly arriving at and departing from that port, I was most forcibly impressed with the insufficiency of the present entrance to the harbor, and the imperious necessity of another channel of communication between it and the lake. This appeared obvious from the elongated shape of the harbor, which is formed by Buffalo creek—a narrow but deep stream, varying from twelve to eighteen feet in depth, being sufficient to float any vessel on the lake. At its mouth, Government has erected a substantial pier, which effectually protects and keeps open the entrance; and here is a light-house duly furnished and well tended, affording to the mariner a certain guide into port.

The crowd of vessels and the accumulation of business at this point, are such as to be of serious inconvenience; and from an examination into the want of accommodation, and safety of entrance into the harbor, at this end of the lake, for the numerous vessels navigating its waters, my attention was directed to another passage or channel, the construction of which was undertaken by individual enterprise, but left in an unfinished state in consequence of the late revulsion. This channel is located a mile and a half above the mouth of the creek or harbor, across a narrow part of the peninsula which separates it from the lake; and it is my belief that, if completed, it would remedy the evils and inconveniences above alluded to, by affording a choice of ingress and egress to and from the harbor. The whole work, including the finishing of the channel, the completion of the pier, and the erection of a light-house or beacon, will involve but a small expenditure in comparison with the increased safety of the lake commerce; and I recommend to Government their early completion accordingly.

With the intention of more fully fortifying my views and opinions on this subject, I directed inquiries to be instituted, and have obtained from Doctor William K. Scott a communication, accompanied by a sketch of Buffalo harbor and vicinity; both of which are hereunto annexed, and to which I beg leave to refer. This gentleman holds the office of city street commissioner and surveyor of Buffalo, and is represented to me, on unquestionable authority, as enjoying the fullest confidence of that whole community, not only for integrity, but also for excellent judgment. He is a practical civil engineer, and does not own any real estate in that city or vicinity.

"*Buffalo harbor*, as is well known, is constituted of *Buffalo creek*, which, for the distance of about a mile and a half, (or between the
points G and H on the accompanying map or sketch,) runs nearly parallel to the lake shore, before entering into the head of Niagara river; leaving, this whole distance, a narrow peninsula between its shore and the beach of the lake. This stream, from its mouth to the distance of nearly two miles, affords abundant depth for all the purposes of a harbor, being from eleven to sixteen feet throughout; as shown upon a map of the city, drawn by the city surveyor, W. B. Gilbert, and published in 1837. The entrance to the harbor is at the mouth of the creek, at its junction with the Niagara river. In a state of nature, this mouth was annually shoaled by a sand bar, thrown up by the lake surf, to from one to three feet in depth, which was consequently not passable with vessels. To remedy this evil, efforts were made to engage the General Government in the erection of works to break off the surf; but such were the doubts entertained with regard to the efficiency of such works, that all applications for that purpose proved ineffectual, until individual enterprise in the inhabitants of Buffalo erected a temporary work as an experiment. The result of this experiment was wholly satisfactory; and the General Government has since constructed a permanent and efficacious pier, which has at all times fully protected and kept open the channel at its full depth. A light-house upon the extreme end of this, guides the mariner in his course to port.

"When the Erie canal was constructed, so little did the fathers of that great work dream of the future greatness of the trade of the West, and the consequent demand for canal-basin room at the western termination of their labors, that they made no provision for a basin for boats at this port, save the short space from A to B, and only connected the Erie canal with the harbor at one point, marked C in the accompanying sketch. The necessity of passing, with equal facility, with all canal-boats, to each storehouse, and to every part of the harbor, is apparent to all; yet, by the State authorities, no such facilities have been provided. The passages marked D and E, for connecting with the harbor, have been provided by private enterprise, and are all confined to the western part of the harbor. The effect of this state of things has been to assemble and confine the vast business of this port to a small portion of the west end of the harbor, and that portion has consequently become crowded to an inconvenient degree. It is this circumstance, and not any want of actual room in Buffalo harbor, that has given rise to the opinion which to some extent prevails, namely, that our harbor is not of sufficient capacity. Early aware of the evils here spoken of, the corporation of our city, with the view of rendering such aid for their removal as their corporate powers permitted, laid out and established the extensive basin marked F. This basin, it will be seen, lies nearly parallel to Buffalo harbor; its width is one hundred and twenty feet, and its length a little more than a mile, affording ample room for all boats that may need to occupy it; and by connecting at Main street with the Erie canal, and a towing-path upon its bank, in prolongation of that of the Erie canal, the passage of all boats with facility to the extreme end of this basin will be amply provided for; while, by canal-cuts across the tongue of land between this basin and the harbor, such boats may be passed to and from the harbor at such points as may be most
desirable. Two such cross-cuts, marked I and J, are already laid out and established. Nearly two thousand feet in length of the basin F is already finished; and one of the cross-cuts is also in a great state of forwardness, although, at present, from the depression of trade and consequent scarcity of money, the labor upon the works is suspended. These works, when completed, will fully accommodate our canal commerce, and amply provide for connecting it, at suitable points, with the harbor; thus bringing it in immediate contact with the shipping of the lakes.

"But these provisions, ample as they are, cannot, alone, abate the desire to keep all business at the west end of the harbor. This desire arises, in part, from a dread of placing any shipping far from the mouth of the harbor, because of the difficulty, at certain times, of making way through the crowd of craft below, when going to sea. This is an evil of serious magnitude; since, by its operation, more than three-fifths of the entire harbor has, to this day, been at all times wholly unoccupied. The remedy for this is manifest to all, namely, another entrance; the facilities for which nature has provided, and which were pointed out and commented upon by the original surveyor of our city grounds, near forty years since. Guided by these, private enterprise has commenced the construction of a second entrance to Buffalo harbor. The work was contracted for, and upwards of forty thousand dollars had been expended upon it, when the late revulsion in trade checked the progress of the undertaking. The channel in question will be found upon the accompanying sketch, marked 'south channel.' At this point the peninsula is but eighty rods in width, and the channel is mostly excavated and substantially sheet-piled upon both sides. The pier, too, at the entrance, was well advanced; but, being left in an unfinished state, has been partially destroyed. The grounds occupied by this channel have been fully dedicated to the public by the proprietors, so that no private interest exists, or is intended to be retained, in the work when finished. The width is two hundred feet, which is greater than the channel portion of the present entrance. The construction of such a work is very manifestly the province of the Government, rather than that of individuals; and the adoption of this, and its speedy completion by the General Government, I know to be anxiously desired in this community; such an expense it is manifestly and unjustly onerous to throw upon individuals, who can reap no other than their share of the general advantages from the measure; and yet our present necessity for it is most pressing. With a suitable pier, to serve the same purpose as the one at the other entrance, and a light-house, as in that case, upon its outward extremity, the facilities for ingress and egress of vessels would be such as few harbors enjoy, and such as would wholly remove every difficulty now arising from a thronged entrance. Before this work was undertaken, I learn that Captain Henry Smith, of the United States engineers, and other individuals deemed competent to decide, examined the position with attention, and pronounced the work feasible at a moderate expense. They also gave it as their opinion, that, when finished, it would fully answer the end intended, and that, so far as they could judge, no evils of any kind were to be apprehended from its construction. With many
of the mariners upon these lakes I have conversed in regard to the utility of such a passage, if constructed. They concur in the opinion that it will fully relieve all crowd at the entrance; and they mention some advantages which that mouth of the harbor would have over the other. These I will repeat: Off the present mouth, there is a current of about two miles per hour; this current is encountered, and must be overcome, by all vessels leaving port; and it follows that sail-craft can only leave port when the wind is such, by its direction and strength, as to enable them to overcome this current. The mouth of the ‘south channel,’ on the contrary, opens into a wide bay, with no perceptible current, and affording vessels every facility of departing from the pier-head, upon either tack, according to the wind, without feeling the influence of the current. This passage also will occasionally be open earlier a few days in the spring than the other. Once, within a few years, the lake was all open from this point five days before the present entrance was free from ice; but this, though it would have been highly valuable at that time, and very possibly may occur again, yet it cannot be supposed that such priority can be generally depended upon. The General Government is now engaged in the construction of a sea-wall along the lake-shore of the peninsula above mentioned, from the present pier to the ‘south channel.’ This will preserve the harbor, the whole length, from the immediate action of the waves during gales of wind; but, so far as I know, no other method than the construction of this new channel can render that harbor available throughout its whole extent; and which, when thus made available, will be ample for all our wants. The dotted lines seen in the accompanying sketch, upon the various portions of the banks of the harbor, and parallel thereto, mark the intention our common council has entertained in relation to widening the harbor. They find, however, they have not the power to do this by levying a tax; and so the matter rests. Some of the owners of the lands across whose front these lines run intend to excavate these portions themselves; such, I learn, is the intention of the owners of the portion thus marked, nearly opposite where the ‘south channel’ enters the harbor. Should it come within the legitimate province of the General Government to assume and execute this work, and to adopt and complete the ‘south channel,’ with its pier and light-house, I know of nothing more that would be required to complete the necessary facilities for our great and growing commerce; nor do I know of any other method by which this can be accomplished.

“There was a proposition a few years since, originating with owners of property beyond the north bounds of the city, to extend the pier in Niagara river from Bird island upwards, towards our present light-house, with the view of making a harbor between this and the shore. Such an undertaking would involve an immense expenditure, and strong doubts are entertained of its accomplishing the desired end. The plan embraced the enclosing a longitudinal portion of the Niagara river, with the exception of the up-stream end, which was to be left open for entrance. It is urged that the practical effect of such a work, as illustrated in the present works at Black Rock, which are circumstances precisely so, would be for the sediment of the stream to form a bar at its mouth, and
to renew this as often as removed. But, aside from the inutility of such a work, it is contended that its direct influence upon the waters would be most destructive to Buffalo harbor and all its adjacent appurtenances. By a glance at a map of the United States, it will be seen that the Niagara river leaves Lake Erie nearly at a right angle to the general course of that lake. When a gale of wind forces the waters of this lake towards the outlet, the violence of the swell and the greatest accumulation of water will be experienced upon the shore opposite our harbor. It is to counteract the effect of this, that Government is now erecting the sea-wall along the peninsula before alluded to. At such times, more or less of the level grounds upon Buffalo harbor are overflowed. Now, if we suppose a portion of this shore of the river below and near the mouth of our harbor, to be so enclosed as to delay the escape of the surplus waters thus forced upon our shores, the result would be to cause these waters to rise higher upon the shores of our harbor, in proportion to the extent of the obstruction, and the length of time such gale should continue. Such, in the opinion of many, has been the effect, in some degree, of the present works at Black Rock. The territory thus exposed, and which has been occasionally thus temporarily submerged, constitutes almost the whole of the first ward of the city—a ward which pays a heavier tax than any other ward of the city. So evident does it appear, to a large majority of the inhabitants of this city, that an extension of the works in Niagara river would augment the evil of floods in an equal proportion, that they have given their most decisive negative to the proposition. It was brought before the people at a charter election, a few years since, and constituted the question upon which to determine the choice of aldermen. The result was, that of the whole board, consisting of ten members, only a single one was elected that was not wholly opposed to the measure.

"I am, sir, with great respect, yours, &c.,

WILLIAM K. SCOTT."

My attention was next directed to Cattaraugus. At this point the public improvements for a harbor are advancing as rapidly as circumstances will admit; and it may be with justness presumed that the present year will deepen the channel sufficiently to admit vessels into the harbor, although the piers are not yet in a situation to furnish a convenient or a proper spot for the structure of a beacon-light, nor, indeed, to offer protection to vessels. The piers constituting the sides of the channel are in part laid down; and it is quite probable that the depth of the entrance will be sufficient to enable vessels to avail themselves of this port as a place of shelter during the ensuing winter.

The rapid increase of shipping on this lake would seem to require all that the genius of human invention can devise in the formation of artificial ports. Although nature has not fully adapted this point to our wants, it has effected much; so that it only remains necessary for us to force a channel to the entrance of the creek, where we find ourselves completely sheltered from the tempests.

Cattaraugus, in this respect, is one of the many valuable points on the shores of the lake, and will become a great resort for vessels in tem-
pestuous weather, in consequence of the capaciousness and accessibility of the harbor.

I therefore recommend the erection of a temporary beacon, until the works are in a situation to admit of the building a permanent light-house, or beacon, as circumstances may require.

At Silver creek a new beacon-light has been established and finished this season. I find it deficient in lamps, except such as have been furnished by the tender; by whom I am informed that the lamps furnished by the contractors or builders were not fit for use.

The deck of the beacon leaks badly, so that it would be almost impossible for the keeper to stay there during the night in bad weather:

The pier, or crib, on which it is placed, is a good one, with the exception that it requires filling in with stone.

The position of this harbor, exposed as it is to all winds except those from the south and west, renders it sometimes of little avail to the mariner; but yet its commercial importance would seem to require a light at this point.

The fact of its commercial importance is well attested by the efforts that individuals have lavished for the purpose of rendering this harbor safer and more convenient.

Dunkirk harbor is formed partly by artificial means, and is protected by breakwaters from the north and northwest winds. This harbor is spacious, when compared with other harbors on the south shores of Lake Erie; consequently, its importance, in a commercial point of view, is worthy of the most favorable consideration on the part of the Government.

A pier is about being erected within the harbor, and directly opposite the entrance, which, it is presumed, will effectually destroy the force of the waves. When this is accomplished, the most important objections to Dunkirk are removed.

The light-house at this point has, by the authority of Congress, been discontinued, at your discretion. This step, has been taken, in my opinion, unadvisedly; or, rather, the evidence before Congress, upon which their decision is predicated, was premature. It is a matter of surprise to me that it should have been recommended. Surely the recommendation could not have emanated from the shipmasters navigating the lake; for there is not a light-house on the south shore of Lake Erie that is more conspicuous, or can be seen to a greater distance.

The beacon, at the entrance of the harbor, is indispensably necessary as a guide for vessels, that would otherwise find it hazardous, in foul weather, to reach an anchorage within.

It might have been presumed that the beacon would supersede the necessity of the light-house. This, however, is not the fact; for a single light upon the piers would require an elevation of one hundred and twenty-five feet to overtop the bluff point on the northwest, and even in that case not afford the proper facilities for navigation.

In conclusion, I will observe, that the light-house, dwelling, and beacon are in excellent order, with no deficiencies.
Van Buren harbor, situated about five miles southwest of Dunkirk, can, by artificial means, be made a harbor of safety. It is formed by an indentation in the shore of Lake Erie, having on the northeast a sunken reef of rocks, extending in a northwesterly direction, about half a mile into the lake, with a point of land on the west and northwest, and shoal water for a distance of twenty-five rods beyond the extremity of this point. This harbor is naturally well protected from all winds except those from the north and northwest; and it is susceptible of defence by artificial means, such as breakwaters—a means applied with the most favorable results to some of the most important harbors on the borders of Lake Erie.

It must also be recollected that, through individual enterprise, a dock, at an expense of more than four thousand dollars, has been been built for the accommodation of vessels frequently entering this harbor.

It is estimated by competent engineers, that the breakwaters necessary for the protection of this harbor against winds from which nature has supplied no defence, might be built at an expense not exceeding fifty thousand dollars.

In consideration of the natural advantages of Van Buren harbor, and its capability of artificial improvement, I would recommend the erection of a light upon the top of a suitable dwelling for the keeper. The site fixed upon for the dwelling is at the foot of Jefferson street, where I have marked a sycamore stump with the letters B L.

Portland light-house, lighted with natural gas; 11 lamps and reflectors; stationary.

Owing to a failure of gas, that may be attributed to the excessive drought, oil is now substituted. It is presumed, however, that the fall rains will replenish the stream from which the fountain is supplied, and thus prevent the escape and loss of the gas. The recurrence of such a drought will, if ever occurring, be at great intervals, and will not then, probably, render the use of oil for a long time necessary.

The public improvements for forming an artificial harbor are progressing, and the light-house now in use is amply sufficient for all the purposes of navigation, at least until the breakwaters are completed. If, then, it becomes necessary to erect a light on the breakwater, or on the end of the pier, as the case may require, the necessity of the present light will be entirely superseded.

The light-house needs a coat of Roman cement, which can be put on at a cost of one hundred dollars.

Slight repairs are necessary for the dwelling; fifty dollars will be amply sufficient for that purpose.

A new well will also be necessary, as the well formerly in use is unfit; this may be done at a cost of fifty dollars, making a total cost of two hundred dollars.

Presque Isle light-house, 10 lamps, fixed. This light is considered one of the most useful on the south shores of the lake, and is kept in first-rate order. I find here, again, a fault in the chimneys, being too short, not reaching above the scallops of the reflectors. The dwelling, and everything appertaining thereto, is without fault.
The beacon, standing on the pier, is in as good condition as the mutilated state of the pier will admit. It should be rebuilt, as well as the dwelling in which the tender resides, but, before undertaking to rebuild either of these buildings, it will be both judicious and economical to remodel the pier with stone. When this is accomplished, one thousand dollars will be amply sufficient to establish the beacon now erected on a solid and permanent foundation, and an expenditure of five hundred dollars will render the dwelling comfortable.

The bay forming this harbor is five miles in length, and with an average breadth of one mile. The depth of water is sufficient for any vessels navigating the western lakes, and when the public improvements in contemplation are completed, it will be one of the most extensive, as it certainly now is one of the best harbors on the lake, being accessible in any state of the weather.

The commercial advantages to be derived from the accomplishment of a western entrance to this harbor would seem to merit the first and most favorable consideration of the Government. The public works are progressing, and in September last, when my attention was directed to this point, vessels laden with stone, and drawing four feet of water, passed through this channel, then five feet in depth. It is obvious that with the assistance of breakwaters and piers at the western entrance, a channel of sufficient depth will soon form itself. The practicability of such measures has been demonstrated by the success of a similar experiment at the eastern entrance of this same harbor. But I trust that the advantages to be derived to commerce, by immediate attention to that point, will make manifest the propriety of early and liberal appropriations.

When this channel is finished, vessels and steamers may avoid a circuitous route of ten miles around the peninsula, by passing directly through the bay, a course six miles shorter.

The inestimable value of this harbor, in the event of a war with Great Britain, for the building of vessels, or for a military or naval depot, will justify appropriations, not only for the completion of that already in contemplation, but eventually for rebuilding with stone the breakwaters and piers at the eastern entrance.

**Conneaut River beacon, Lake Erie, State of Ohio.—** This beacon, situated at the outer end of the piers forming the entrance to the harbor, is built of wood, and is lighted with four plain lamps. These are not deemed sufficient; Winslow Lewis’s patent lamps are, therefore, recommended to be substituted in their stead. Forty dollars, it is estimated, will supply the deficiency. With this exception, the beacon and materials furnished by the contractor are without fault.

Here I find it necessary to submit an estimate for a dwelling. The keeper has heretofore been under the necessity of renting a tenement, at a cost of seventy-five dollars per annum to the Government. A building one and a half story in height, measuring thirty-two by twenty-five feet, so partitioned as to make two rooms, with a bed-room and ladder on the first floor, and two arched rooms on the second floor, with a good cellar, may be built for one thousand dollars, of stone or brick, under contract. The necessary outbuildings, with fences, including a well of
water, may be constructed for two hundred dollars. A lot of one-fourth of an acre can be purchased for the same amount, making a total cost for house and appurtenances, with a lot, of fourteen hundred dollars.

This is an important and safe harbor. The piers will soon require rebuilding, and it will be economy in the Government to do it effectually with stone.

Ashtabula beacon is lighted with eight lamps and six red reflectors. It is situated on the extremity of the east pier forming the entrance to the harbor, and is kept in excellent order. This is an excellent harbor, and sufficiently spacious to accommodate twenty vessels.

Here, again, it is necessary to submit an estimate for a dwelling for the keeper, which may be built of stone or brick for one thousand dollars, by contract, of the following dimensions: twenty-five by thirty-two feet, one story and a half high, partitioned so as to form on the first floor a bed-room, pantry, kitchen, and parlor, with two arched rooms on the second floor, with a good cellar. The necessary outbuildings and fences, with a well for water, may be built for two hundred dollars. A lot of ground of one-fourth of an acre can be bought for two hundred dollars, making a total amount of one thousand four hundred dollars.

Cunningham Creek beacon is situated on the outer end of a single pier, extending about four hundred and fifty feet into the lake. It is lighted with three lamps, and is built on a new plan, having no stairs. The lamps are raised and lowered by pulleys. It is kept in excellent order, and the plan is a commendable one for temporary purposes. The public works are fast progressing, and the time is not far distant when a partial protection will be afforded to commerce at this point.

The dwelling is in a state of dilapidation, but an appropriation of three hundred and fifty dollars will be requisite to render it comfortable.

Grand River light-house is lighted by thirteen fixed lamps, and the same number of bright reflectors, all in good order. The beacon, on the east pier forming the harbor, is lighted with four lamps, and is in perfect order. This pier extends six hundred feet into the lake; the west pier nine hundred feet. By bringing the light-house and beacon in range, in coming from the west, there is no difficulty in entering the harbor; consequently, there is no objection to the location of the beacon on the lesser pier. The width of the entrance between the piers is one hundred and seventy-five feet, with a depth of fifteen feet. The harbor is large enough to accommodate one hundred vessels, extending two miles up the river, with twenty feet depth of water after passing the entrance. The piers will evidently require rebuilding in a few years, and if the work be made permanent with stone, a beacon-light may be erected at the end of the pier that will supersede the necessity of the present light-house. Until that is accomplished, I consider the light-house absolutely necessary.

Cleveland light-house is lighted with eleven lamps. The number of reflectors is thirteen, all in good order. The beacon is lighted with four lamps, and the same number of reflectors. The beacon stands on the east pier, extending six hundred feet into the lake. The business that is transacted at this place gives the harbor a pre-eminence in the estimation of all, which its own capaciousness and adaptation to an extensive
commerce fully sustain. The piers are now undergoing rebuilding, with huge blocks of granite.

An addition of four lamps to the beacon will supply the mariner with all the necessary guidance for entering this harbor. After such an addition has been made to the number of lamps in the beacon, the light-house may be dispensed with.

It is true that the light-house could be seen to a greater distance than the beacon, but the height of the adjacent coast, and the entire want of shoals or hidden rocks near by, entirely obviate the necessity of a light conspicuous farther than the beacon would be distinguishable.

Black River beacon is lighted with eight fixed lamps, and the same number of bright reflectors. The latter want silvering. The beacon leaks badly; the frame of the cupola wants soldering, the glass puttying, and other trifling expenses are necessary to prevent leaking; all of which may be done for twenty-five dollars.

The beacon stands on the west pier, which extends 680 feet into the lake. In order to render it safe for the tender to approach the beacon, in foul weather, it will be necessary to raise the pier at least two feet. At three different times last year, such was the violence of the waves, that persons endeavoring to light the beacon were washed from the pier, one of whom was drowned.

This is an excellent harbor, with ten feet of water for more than three miles up the river. The width at the entrance of the harbor is 175 feet, which is probably the average width of the river. It is capable of accommodating at least fifty vessels.

Huron beacon is lighted with eight lights, and as many bright reflectors, fixed, and all in good order. The beacon stands on the west pier, which extends 900 feet into the lake. This is an excellent harbor, having from 11 to 18 feet of water for more than six miles up the river. The entrance between the piers is 175 feet in width, which is the average breadth of the river as far as navigable. Between the piers, however, we find but 11 feet of water.

I heard great complaints from the keeper of the light respecting the oil furnished by the contractor. The summer oil is not fit for use, and the winter oil is not equal to the summer-strained beretofore furnished. The piers at this place need a greater elevation of two feet, to obviate the present difficulties in gaining access to the beacon in foul weather.

Sandusky light-house has fifteen lamps, and thirteen lighted with thirteen bright reflectors; all in good order and fixed. The light is in commendable order, and the materials furnished by the contractor are faultless. This light-house is an important one, from its favorable location, in making the spacious bay of Sandusky.

Upon Cedar point, at the entrance of Sandusky bay, is about being erected a beacon-light. It is contemplated placing the lantern on the building in which the tender is to reside—a plan always commendable when the locality of the light will allow. I find, on examining this point, that the lake is making fearful inroads upon the shore; and, to prevent future calamitous consequences, I deem it essentially important that crib-work, filled with stone, be extended from the Hog’s-back (so called) to the extreme point of the cape, a distance of about 150 feet. When
this is completed, the waves will soon overlay it with sand, and thus afford permanent protection to the intended site of the beacon. The expense attending the construction of crib-work, four feet in width and three in height, will be but trifling, as the whole would not exceed $500.

It is believed that the present appropriation of $3,000 will be sufficient to defray all the cost of the dwelling, necessary out-buildings, and crib-work. This was certainly the opinion of Mr. Starkweather, the collector at Cleveland, in whom the contracting power is vested. The utility of this light in entering the bay has doubtless been fully represented; and I will only observe, that the most favorable report with regard to it meets my full concurrence.

*Port Clinton light-house* is lighted with eight lamps, and as many bright reflectors; everything in good order, with the exception of the chimneys, which are too short, not reaching above the scallops of the reflectors. With the above exception, everything pertaining to both the light-house and the dwelling is without fault.

I am decidedly of opinion that this light may be discontinued without the slightest detriment to the commerce of the lake. It affords no assistance in making a harbor, for there is none in the neighborhood; the coast is free from rocks or shoals, with a bold shore, conspicuous to the mariner, and easily avoided.

*Turtle Island light-house* is lighted with eight lamps, fixed; the number belonging to the establishment is eleven, with as many bright reflectors. The lamps are in bad condition, from long use. The tender seems to have performed his duty faithfully. This is certainly one of the most important lights on the lake, not only on account of its proximity to the Maumee river, without which it would be difficult to approach the ports of Toledo and Manhattan, (both thriving villages, which, possessing the advantage of unexceptionable harbors, and with the internal improvements of railroads, &c., some of which are already in operation, must soon acquire a rank among the most favored ports on the shores of Lake Erie,) but as a general landmark to the mariner on his passage through the lake.

The measures already taken by the Government for preserving this island will undoubtedly be amply adequate to the object. The work is progressing rapidly, and will soon be completed. The island does not, at this time, embrace more than three-fourths of an acre of ground. The new channel into the Maumee bay, which is on the south side of this island, has of late been surveyed, and buoys have been planted, designating the channel, by Captain Dobbins, of the United States revenue cutter. The best route through the bay has also been buoyed out.

*Otter Creek Point light-house, State of Michigan.*—This is lighted with eleven lamps, and as many bright reflectors, fixed. This light, situated at a distance of seven miles north from Turtle island, in La Plaisance bay, is serviceable, and indispensably necessary for the commerce of Monroe, until a light is established at the new entrance to the harbor.

This improvement consists of a ship canal cut across a point three-fourths of a mile in length, 100 feet wide, and about 12 feet deep, connecting the deep water of the river with the deep water of the lake, and affording the only remedy to the present defect in this harbor—a very
extensive and troublesome bar of shifting sand, at the mouth of the river. The canal is merely a new mouth to the river; and the piers already completed, or nearly so, will prevent the accumulation of a bar at the mouth of this artificial channel.

This work (I judge from my own observation) will be completed about the 1st of July next, if Congress should make the necessary appropriations this winter; the cost of which, as estimated by Colonel Henry Smith, engineer, will be about twenty-five thousand dollars. A beacon-light on one of the piers at the entrance will be absolutely necessary, and will supersede the necessity of the present light-house. A dwelling for the tender will also be necessary; for all of which I would recommend an early appropriation. An estimate of the amount required is respectfully submitted, and annexed.

There is, perhaps, no point on either of the lakes of greater importance than the mouth of the river Raisin. It is the only artificial harbor on Lake Erie, in the State of Michigan; and that State, aware of the great commercial importance of this position, is now constructing a State railroad from Lake Michigan to Monroe, (the city at the mouth of the river Raisin,) that will pass through the whole length of the southern and most fertile tier of counties in Michigan, and through a district along the line entirely settled, and under cultivation. The road is now nearly completed for the distance of about sixty miles, commencing at Monroe; and that distance, or more, will doubtless be completed early in the ensuing season.

The railroad will, of course, be comparatively unproductive to the State until the completion of the harbor, and the establishment of the beacon-light at its entrance.

Monroe is an incorporated city, and the second town in commercial importance, as well as in wealth and population, in Michigan. The number of its inhabitants is between three thousand and three thousand five hundred. The town is advantageously situated on both sides of the river Raisin—across which stream two bridges have been built above the head of navigation, and two more are about being constructed—including within its limits an immense hydraulic power, while it also embraces the head of navigation for laden vessels of the largest class. This place also forms the termination of three railroads now in progress, (including the State road,) three or four others projected and chartered by law, and eight or ten ordinary roads.

I offer this brief statistical notice, believing that the Department will concur with my opinion of the great importance of this point as a port of refuge for vessels in foul weather.

An estimate for a beacon and dwelling will be forwarded in a few days.

_Gibraltar light-house, at the mouth of Detroit river, on the western channel._—This is lighted with eleven lamps and an equal number of reflectors, fixed. It is a new building, and in excellent order, although (in consequence of the severe indisposition of the tender) there had probably been just grounds of complaint for a few days preceding my inspection of the establishment. I am inclined to believe, however, that the
keeper is doing his utmost, and will, on his recovery, give perfect satisfaction.

The dwelling is also a new building, of brick, and without fault, except that the cellar requires draining, and the chimneys are out of order. To remedy the former fault, it will be necessary to dig a trench of thirty rods, at a cost of thirty dollars, including all the contingencies. Weather-finders, it is presumed, will remedy the latter defect, at an expense of six dollars each; making a total cost of forty-two dollars.

This is an important light, and the termination of the line of light-houses between Buffalo and Detroit, being eighteen miles distant from the latter place.

Having concluded my observations and surveys of the light-houses on this lake, my attention is next given to the location of buoys to be placed on a large and dangerous shoal or sunken island near the Western Sister isle, and to the southward thereof, and situated directly in the route of vessels bound for the Maumee river.

Its length is half a mile, and its breadth fifty rods. The depth of water at its extreme points is two fathoms, and upon the shoal varies from five and a half to eleven feet. I have now placed a buoy on this shoal to ascertain the possibility of buoys withstanding the force of the moving ice in the spring. Three others are prepared for being located upon this shoal, should the experiment prove its expediency.

But the importance of marking this shoal with some object conspicuous at all times, renders the location of buoys upon it rather improper; and I would, therefore, recommend the erection of a monument at this point. The bottom of the shoal being solid rock, such a work, when completed, would be in no danger of being washed away by the water or the ice; and, if well constructed, would need little or no repairing.

The dimensions of the monument should be as follows: From its base to the surface of the water, twenty-five feet square, built of timber, and filled in with stone. Above the water, an octagonal pyramid, ten feet in height, should be raised, built also of timber, and filled in with stone. A monument constructed in this manner would, in my opinion, be both durable and cheap, and also at all times visible to the navigator in its vicinity. Its necessity will be obvious from the fact of its distance to the West Sister island, the nearest land being seven miles.

It is estimated, after taking into consideration the disadvantages under which the contractor or superintendent must labor, that the cost will not vary much from thirteen hundred and forty dollars. The quantity of stone required will be fifty-five cords, and cannot be delivered at this point for less than eight dollars per cord. This, of itself, amounts to four hundred and forty dollars. The timber will be another item, amounting to two hundred and fifty dollars; the iron bolts, &c., fifty dollars; labor, four hundred dollars; contingent expenses, two hundred dollars.

Having concluded my report with respect to Lake Erie, I will now commence with Lake Ontario, beginning with

**Niagara light-house.**—This light is situated on the mess-house, within Fort Niagara, at an elevation of 70 feet above the water. It is a good light-house, situated at a point convenient for the mariner, and the ex-
excellent order in which it is conducted gives high credit to the keeper. It is lighted with 9 lamps and an equal number of reflectors, fixed.

The works now in progress under the direction of Captain Smith, of the engineer corps, it is presumed, when finished, will effectually protect the banks from being washed away by the waves.

The dwelling belonging to this establishment is in excellent condition.

There are some few repairs required among the fixtures at the light-house, all of which may be done for ten dollars.

**Oak orchard.**—At this point the public improvements are progressing rapidly; three hundred feet of the piers, on either side, are finished, or nearly so. It is contemplated extending them to a further distance of nine hundred feet, making the total of each pier twelve hundred feet. It is presumed, when these piers are finished, that the current from the creek will clear a channel of sufficient depth, without resorting to other means. If, however, dredging should be found necessary, that can easily be accomplished, in a single season, after the piers are in proper condition.

This must become a port of vast importance for vessels in foul weather, the harbor being spacious, with a depth of from 14 to 20 feet of water for two miles up the creek.

When these piers are in a condition to admit of the structure of a beacon-light, it will be both judicious and proper to submit a plan and estimate for the same; until then, there will be no possibility of entering the harbor.

**Genesee light-house** is lighted with 10 lamps and the same number of bright reflectors, fixed. The lamps are in bad condition, owing chiefly to wear. So far as the keeper is concerned, all is correct. The oil and other supplies furnished by the contractors are without fault.

The light-house wants repairing; the deck leaks; the lantern wants glazing, fourteen of the glass being more or less broken. * * *

This light-house, it will be recollected, may be discontinued as soon as the one recommended in a former report is established at the end of the pier.

**Sodus Bay light house.**—This is a first-rate revolving light, and, from its conspicuous location, affords to the mariner all that can be expected. It is lighted by ten lamps and the same number of reflectors, without fault.

The beacon on the west pier is built of stone, and fully answers the purposes for which it is intended—a mere guide for entering the harbor.

The piers are in a shattered condition, and will soon have to be rebuilt; and when this is done, it is presumed the Government will extend to it the same liberality that it has so justly bestowed upon other harbors requiring the like remodelling.

The excellent qualities of this harbor are too well known by the mariner to need further comment, and it must eventually become a port of immense importance in a commercial point of view. Nature has given to it that protection which must entitle it to the most favorable consideration of the Government.

**Oswego light-house, or beacon,** is lighted with thirteen lamps, with the same number of bright reflectors, and located on the west pier, at
the entrance of the harbor. This is a first-rate building, and is kept in excellent order. The supplies furnished by the contractor are without fault. The public improvements in the rebuilding of the piers are in rapid progress, and, when finished, will remain for at least a century. This is a splendid harbor, extending about half a mile in the river, with sufficient depth of water for the largest class of vessels; its breadth is about 2,400 feet.

The commercial importance attached to this harbor is such as places it beyond competition on this lake.

The old light-house is in a dilapidated state; the fixtures, however, are taken care of, and are in the possession of the keeper. The dwelling wants trifling repair; all of which may be done for fifty dollars.

_Salmon River light-house, on Port Ontario._—This is a new light, just established, and is fixed on the keeper's dwelling. It is lighted with eight lamps, and the same number of bright reflectors, all in first-rate order. The supplies furnished by the contractors are good.

The importance of a harbor at this point is evident on an examination of the chart of Lake Ontario. Mexico bay, into which Salmon river empties itself, forms the southeastern extremity of the lake, and is contained between Stony point on the north and Nine-mile point on the south; having a length of shore of about forty miles, with not a single harbor for vessels drawing over five feet. A vessel found within this bay during westerly gales cannot beat out for want of sea-room, and, of course, must go on shore from the want of a harbor. Salmon river discharges near the head of this bay, and is the most considerable stream emptying into it; of course a better harbor can be constructed here than at any other point in the bay. Off the mouth of the river is found a bar having a depth of water, in different seasons, of from five to nine feet. To remedy this defect of nature, it is proposed to run out a double line of piers, to fourteen feet water. To effect this, the southwest pier will require to be 1,815 feet, and the northeast pier 1,090 feet in length, to be 30 feet in width, and constructed of heavy timber, and filled in with stone. With respect to the commerce of this harbor, I can say but little; yet, on inquiry, (having no other data,) I find, during the past season, about 1,500,000 feet of pine lumber, 200 tons of cheese, 5,000 bushels of potatoes, 50 tons of butter, and a considerable quantity of potash, have been shipped here; flour, salt fish, limestone, and merchandise, constitute the articles generally brought here. Several vessels are owned here, amounting to about 950 tons.

Three years since the village of Port Ontario was not in existence; seven or eight buildings occupied its present corporate limits; it now contains between five and six hundred souls, and is quite a thriving place. A charter has been granted by the State legislature for the construction of a canal hence to the Oneida lake, which will open a water communication with the Hudson, over, it is said, the shortest route. Of the practicability of constructing this canal I believe there is no doubt, as it is asserted that the surveys warrant the belief of its easy accomplishment. The water-power of the river is considerable, and can be easily brought into action in the village by cutting a hydraulic canal along the bank.

I will conclude by merely stating that the harbor, when the piers are
completed, will afford protection to vessels unfortunately driven into Mexico bay; there being sufficient water and good anchorage ground for at least thirty vessels.

**Stony Point light-house.**—This is a revolving light, and is lighted with ten lamps, and an equal number of bright reflectors. It is a new light, with the light on the keeper's dwelling. The dwelling is two stories in height, which gives the lantern an elevation quite sufficient for all nautical purposes. This is a very useful and important light, and is kept in excellent order. The supplies furnished by the contractor are all right.

**Horse Island light-house.**—This is a light on the top of the keeper's dwelling, and is lighted with eight lamps, and the same number of reflectors, fixed. It is an excellent light, and is kept in a manner that gives general satisfaction. It is by means of this light that the mariner finds his way to Sacket's Harbor.

The dwelling is in good order, and the supplies furnished by the contractor reported good.

**Galloo Island light-house.**—This is a fixed light, and is lighted with fifteen lamps, and the same number of reflectors; some of the lamps require repair, which business will be attended to by Mr. Simonds, employed by the contractor for that purpose; otherwise, all is in good order, so far as relates to the lights. The lantern leaks but little; the deck, however, is extremely leaky. The exterior of the light-house needs a covering of Roman cement, the cost of which will be about one hundred dollars. An appropriation of $1,800 has been expended in the construction of a pier or crib-work, to defend the dwelling of the keeper from the surge, which, impelled often by gales that have the sweep of the whole lake, envelop the outermost extremity of the island with dashing billows, and tend to undermine the buildings there erected. The crib-work is now but partially finished, and therefore affords, as yet, but an incomplete defence. It is presumed that an extension of this crib-work thirty feet in a southeasterly direction will prove more effectual for such purposes; and for that purpose two hundred dollars is estimated as quite sufficient. The lake at this time maintains a height of three feet above its usual elevation; and it is probable, from the advanced state of the season, that but little fall in its level may be expected. Taking, consequently, the present height of the water as a medium for calculation, it is deemed essentially important to make an addition of the length, and in the direction, both before mentioned. It is proper to observe, that the dwelling now stands but twenty feet from the wall, or rather crib-work, that was previously mentioned, and that it will ever be very difficult entirely to shield it from the waves; and it will, perhaps, be as proper to add, that the shore of the island is now twenty rods farther in than at the time of the erection of the light-house—a circumstance to be attributed no less to its washing away than to the unusual height of the water.

The dwelling is very much out of repair. The roof leaks, and the settling of the foundation has deranged the window-frames, which consequently afford but little protection from rain. A new floor is necessary for the kitchen; slight repairs in the walls are also wanted. The cellar, filled with water from the extreme height of the lake, is useless; and it
would be a feasible expedient to fill up the old cellar, and erect, on some convenient spot above ground, such a cellar as is needed. Two hundred and fifty dollars is estimated as sufficient to repair the house, and to fill up and make a new cellar above ground.

Sixty dollars have been appropriated for the purchase or construction of a boat for the keeper. This sum is deemed quite inadequate, as it has been ascertained that such a one as is proper cannot be built for a less sum than $120. The dimensions of such a boat are 20-feet keel, open aft, with a forecastle; making a total amount (including the crib-work, Roman cement for light-house, repairing of dwelling and cellar; and sixty dollars additional sum for a suitable boat, and twenty-five dollars for the necessary repairs to the light-house) of six hundred and thirty-five dollars.

With the foregoing observations, I respectfully submit this report; which, you will observe, relates only to the location and condition of light-houses. As far as relates to the location and condition of buoys, the season was so far advanced before I had accomplished the duty to which, from your instructions to me, my first attention was directed, that I found it impossible to make any examination in relation to them, and consequently will have that duty to perform next season.

Having concluded my report with respect to Lake Ontario, the following will be found applicable to the river St. Lawrence:

Tibbet's Point light-house — This light, situated on the east side of the entrance of the St. Lawrence, is lighted with ten lamps, and the same number of reflectors. The light-house is in bad order; the lantern leaks, and needs painting; a coat of Roman cement, upon the outside, is also needed; all of which may be done for one hundred dollars. The dwelling is also in a bad condition; the roof leaks extremely; a new covering to the roof is absolutely necessary, and can be done for fifteen dollars. The dwelling will also require some little painting; and the cost, including the lantern to the light-house, will be about eight dollars; making a total of one hundred and twenty-three dollars. This is a very useful light, and is kept in tolerable order. The supplies furnished by the contractor are without fault.

It will be recollected, in a former report of mine respecting the location of lights on this river, that I recommended one to be established at Bartlett's point, and that I did so under the conviction of its ultimate advantage to the commerce of this river, I have no hesitation in repeating. Still, there are other important points of equal interest to the safety of navigation through this difficult and perilous river. And with this view of the subject, I conceive it my duty to represent, in the strongest terms, the necessity of establishing a beacon-light upon Cross-over island, eight miles above Morristown. This island is situated between the two channels, and will be a guide for either. It would be a difficult task to attempt an adequate representation of the numerous shoals and sunken islands obstructing the navigation of this river; generally, however, they are located in the neighborhood of the Thousand Islands; and it is in the midway of this cluster of islands, and the only feasible channel, that Cross-over island, on which it is proposed to erect a beacon-light, is situated.
Cross-over island, is about eight rods in length, and five rods wide; is a solid rock, with a few trees, that have taken root through the crevices of the rocks. It is proposed to erect a building for the keeper, and to place the light on top. This may be done, and the building so constructed as to admit of a cellar above ground, by giving the walls a sufficient height to admit of embankments, which it is presumed will effectually protect the basement story from frost. This may be done for a trifling expense, compared to the blasting of a cellar from a solid rock.

* * * * * * *

Ogdensburg light-house.—This is a fixed light, and is placed upon the dwelling upon which the keeper resides. It is lighted with ten lamps, and an equal number of reflectors, and is kept in the best possible order. The dwelling is now undergoing repairs, under an appropriation of $300.

The river is now three feet higher than its usual elevation. It is presumed, however, that it will regain its former level within two or three years; in which event, all will be well, and in good condition. But should the river continue at its present height, the garden will be perfectly useless, for it is partially overflowed with water. The house is inaccessible itself from the main land, unless by means of a boat. The house is amply protected, by means of the repairs recently made about it, and is in most excellent order.

For the further protection of the garden, it is found absolutely necessary to fill up the space of sixty feet of the sea-wall that was originally built for that purpose. It must be understood, that, at the time of building the sea-wall for the protection of the garden, the space of sixty feet, for which an appropriation is now asked, was, for some cause, (probably for the want of means,) left open. The unusual height of the river at this time completely overflows the garden, when, if this breach were properly filled, the present overflowing of the premises would be obviated. Sixty dollars is computed sufficient for that purpose; and fifty dollars is further required for raising the foundation on which the wood-house, &c., stand. With these improvements, the situation of the keeper may be made comfortable, notwithstanding the river retains its unusual height.

This light being the conclusion of my duties on this river, (St. Lawrence,) I next proceed to Lake Champlain.

Cumberland Head light-house.—This is a new building, and is lighted with eleven lamps, and as many bright reflectors. The buildings, including the dwelling, &c., are finished in a manner highly creditable to the contractors.

Although this light affords to the mariner all the facilities required for entering or departing from the harbor of Plattsburg, yet it is found, on approaching from the north, to be entirely hidden until within fifty rods of the point on which the light-house stands. This fault it will be found difficult, if not impossible, to obviate. It is believed by many that the thick and lofty forests directly north of the light, if cleared away, would render this light conspicuous for some eight or ten miles north. I am inclined to differ in opinion on that subject; for, on examination, I have satisfied myself that the point of land directly north,
and at a distance of little more than one mile, commonly called Gravelly point, is considerably higher than the light-house; consequently, the hewing down of the forest before mentioned would add but a short distance before the rise of land would intervene. I do not mention this circumstance with a view of attaching to it any importance. On the contrary, I know the navigation, in coming from the north, at least as far as the light could be seen, however elevated, is clear of shoals or hidden rocks, and so simple that it would be difficult for the mariner to blunder into trouble. I am, therefore, of opinion, that the present location is a judicious one, and well calculated to answer all the purposes for which it is intended.

The supplies furnished by contractors are unexceptionable, and the keeper, I am confident, will discharge his duty faithfully.

*Juniper Island light-house, Vermont,* is lighted with ten lamps, with the like number of reflectors, fixed. Everything appertaining to the supplies furnished by contractors is correct. The light-house is much out of repair; the stairs want rebuilding; the window-frames are completely decayed, and the exterior wants a coat of Roman cement. The dwelling wants painting, (the wood-work, inside and out.) A new pier is also required for the safe landing of boats.

---

*Split Rock light-house.—This is a new establishment, and at the time of my inspection not in a sufficiently finished state to admit of lighting, although I have good reason to believe it now in the full tide of operation. The buildings are permanent, of stone, and the location well calculated to give general satisfaction.*

I find on my surveys of this lake (and I may add from my own experience during the war) that there are other points requiring beacons, which the safety, with the rapidly-increasing commerce of this lake, makes indispensably necessary, and to that end I have made the necessary examinations and surveys, and have fixed upon sites at the following points, viz: Windmill point, Vermont State, and Crown point, New York State. To make manifest the importance of establishing permanent lights at the above points, I will merely state that temporary lights have been kept at either point for the last eight years, and at the individual expense of the steamboat masters. These lights, however, are frequently found insufficient, and that, too, at a time when they are most required. For instance, during a strong wind, which is not unfrequently the case, accompanied with thick hazy atmosphere, a brilliant beacon-light would render safe the navigation at the aforesaid points, which, under existing circumstances, is often exposed to serious disasters from hidden rocks and the serpentine course of the channel.

With this view of the subject, I respectfully submit a plan and estimate for the location of a dwelling, with lantern on top, at each of the before-named points. The site fixed upon for the building at Windmill point is thirty feet south of the remains of an old windmill at that place, and a short distance south of the line dividing the United States from Canada.
It will be perceived from this report that I have not been able to give my attention on either of the lakes to the location and condition of buoys. All of which is respectfully submitted.

I have the honor to be, respectfully, your obedient servant,

CHARLES T. PLATT,
Lieutenant, U. S. Navy.

Hon. LEVI WOODBURY,
Secretary of the Treasury.

LIGHT-HOUSES, &c.

Letter from the Secretary of the Treasury, transmitting a report of the Fifth Auditor, in relation to the execution of the act of 7th July last, for building light-houses, light-boats, &c.

DECEMBER 13, 1838.—Read, and laid upon the table.

TREASURY DEPARTMENT, December 12, 1838.

SIR: Herewith I have the honor to transmit to you a communication from the Fifth Auditor of this Department, accompanied by documents and reports, setting forth what has been done under the act of the 7th of July last, entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838."

I am, very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

Hon. J. K. POLK,
Speaker of the House of Representatives.

TREASURY DEPARTMENT,
Fifth Auditor's Office, December 3, 1838.

SIR: For the purposes mentioned in the 3d, 4th, and 5th sections of the act of 7th July last, entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838," the President of the United States divided the Atlantic coast into six districts, and the northern lakes into two districts, for each of which a Navy officer has been appointed, viz:

For the 1st district, extending from Eastport to Boston, Lieutenant Thomas J. Manning has been designated.

For the 2d district, from Boston to Newport, Lieutenant Edward W. Carpender.

For the 3d district, from Newport to New York, Lieutenant G. M. Bache.

For the 4th district, from New York to Norfolk, Lieutenant William D. Porter.
For the 5th district, from Norfolk to Key West, Lieutenant George N. Hollins.

For the sixth district, from Key West to the Sabine, Captain Lawrence Rousseau.

On the lakes.—For the 1st district, extending from Detroit to the head of Lake Michigan, Lieutenant James T. Homans was appointed.

For the 2d district, which embraced Lakes Erie, Ontario, and Champlain, Lieutenant Charles T. Platt.

Two copies of the instructions from this office to those gentlemen, and to the collectors superintending the districts to which they were respectively assigned, are herewith enclosed, as are also copies of the respective reports made by those officers, for the use of Congress at the ensuing session.

The only part of these reports which I deem it necessary to notice is that in Lieutenant Manning's, in which he speaks of all the oil at the light-houses in the State of Maine as being complained of as bad in winter. He seems to have fallen into the common error of supposing all the oil to be bad which congeals in winter. The fact is, that the best spermacyoti oil from head matter, pressed in winter, will congeal and become hard whenever the mercury in Fahrenheit's thermometer descends as low as 24 degrees, and oil which will remain fluid at 30 degrees is considered good merchantable oil. In all the Eastern States, therefore, as well as in Maine, the oil at the light-houses must congeal in winter, but, on being heated and put in a fluid state in the lamps, it is kept in a fluid state during the night by means of stoves and oil-heaters, and affords a good light throughout the night. Mr. Anderon, the superintendent of the light-houses in Maine, who examined them in July last, reports the oil generally to be good.

Much has been said as to the importance of inspecting the oil before it is sent to the light-houses. On this subject I am in possession of a certificate from eight of the principal manufacturers of oil in New Bedford, who state "that the oil from different whales is often of different quality, and that they know of no mode of testing this difference of quality but by burning the oil." It is useless, therefore, to inspect it before it goes to the light-houses. In the contract for supplying the light-houses with oil, it is provided that both summer and winter oil shall be of the best quality, and if it is not good when it comes to be tried at the light-houses, the contractors are bound to take it away and supply good. It is their interest, therefore, to supply what they believe to be good oil in the first instance, as the expense and trouble of removing it, if condemned, is considerable.

In pursuance of the 2d section of the act referred to, Captain Perry, of the Navy, was authorized, as early as the 13th July, to purchase, whilst in France and England, whither he was going on other public business, two sets of the dioptic or lenticular apparatus, and such as is used in some of the French light-houses, one of the 1st and the other of the 2d class; and, if he should deem it expedient, to procure also a set of the lamps and reflectors as used in the light-houses of Great Britain. By a letter from him, dated at Paris, the 29th of August,* it appears that he

* A copy of this letter, with my answer, dated 27th September, is herewith enclosed.
had entered into a contract with Mr. Henry Lapouette to furnish the two sets of lenticular apparatus and one lantern, for the sum of 63,037 francs, or 12,607 dollars; the same to be delivered at the port of Havre, in France, in the month of April, 1839, it being found impossible to cause them to be manufactured and delivered at an earlier period. The cost of the lenses being more than was expected, it is probable that Captain Perry will not be able to obtain a set of the English lamps and reflectors. This is of little consequence, however, as these lamps and reflectors are made upon the same principles as those in the light-houses of the United States.

In the expectation that the lenses would be procured and forwarded to this country in season to test their utility before the meeting of Congress in December next, the collector and superintendent at Boston was authorized, by this office, to cause three temporary towers with lanterns to be erected on a hill in the neighborhood of Boston, called Powderhorn hill, from whence the lights could be seen a considerable distance without being exposed to the sea, and endangering vessels sailing along the coast by their mistaking them for other lights. Three towers were ordered to be erected, in order that the apparatus invented by Mr. E. Blunt, the lamp and reflector invented by Mr. Winslow Lewis, and the lenticular apparatus expected from France, might be subjected to experiments by gentlemen of science at one and the same time. Being disappointed in receiving the lenticular apparatus so as to try their efficacy previous to the meeting of Congress, and an application having been made by the agent at Boston, of the improved carcel lamp, for permission to try that lamp, with our parabolic reflector attached, in one of the temporary towers, in connection with the apparatus of Messrs. Blunt and Lewis, permission was granted to him accordingly; he to be at the entire expense of preparing his lamps and reflectors. It has since been ascertained that Mr. Blunt will not be prepared with his apparatus to make the trial before the meeting of Congress, and, consequently, the whole subject has been postponed until the next summer, when the lenticular apparatus will be received, and the experiments, with respect to all, will be made at the same time. The towers, in the meantime, will be taken down and preserved.

According to experiments already made with the improved carcel lamp, used as a house lamp, it affords 2½ times more light than the astral lamp, with the consumption of the same quantity of oil; hence I am sanguine in the expectation that, when connected with the parabolic reflector, it will not only afford a light to be seen sufficiently far, if not as far as any other light, but that it will be more to be relied on, and, at the same time, more economical than any other yet discovered. The fact, however, whatever it may be, will be ascertained by experiments.

In consequence of the great magnitude of the establishment, which may be expected still to increase, I would respectfully suggest the propriety and necessity of being allowed not less than three vessels of about 100 tons burden each, to be employed exclusively in taking care of the numerous buoys on the coast, bays, and rivers, and in conveying persons to examine and report the condition of the light-houses, and the conduct of the keepers, as often as it may be found necessary.
They could also convey persons and materials to make the necessary repairs promptly.

In addition to these, I would suggest the expediency of allowing, by law, to each of the collectors of the large collection districts of Boston, New York, Baltimore, and New Orleans, who act as superintendents of lights, a competent person to aid them exclusively in the execution of light-house duties. With these aids I have no doubt the whole establishment could be kept in a satisfactory condition at a very inconsiderable expense, whether the lenticular apparatus be adopted, or the lighting apparatus now in use be continued.

These vessels being authorized, the experiment could be tried, at the termination of the present contract with Messrs. Charles W. Morgan & Co., of supplying the light-houses with oil, with tube glasses and with wicks, and keeping all the lighting apparatus in repair ourselves. If not so economical as the present mode, it would probably have advantages over it which would more than counterbalance the increased expense.

The lighting apparatus, whether it consists of lenses or reflectors, ought, without question, to be manufactured by the Government itself. Contractors are frequently ignorant of the principles upon which it ought to be made, and are too generally disposed to slight the work, and often do so, to the great injury of the public service.

The report of Lieutenant Hollins has not yet been received at this office. When received, two copies will be prepared and transmitted to you for the use of each House of Congress.*

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON,
Fifth Auditor, and Acting Com. of the Revenue.

Hon. LEVI WOODBURY,
Secretary of the Treasury.

________

TREASURY DEPARTMENT,
Fifth Auditor's Office, August 4, 1838.

SIR: In pursuance of the 3d section of the act of Congress passed the 7th July last, entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838," the President of the United States has divided the Atlantic coast into six districts, and the Northern lakes into two districts, for each of which a Navy officer has been designated by the Secretary of the Navy, for the purposes mentioned in the 3d, 4th, and 5th sections of the said act.

The third district extends from Newport to New York, including the Hudson river, to which Lieutenant G. M. Bache has been assigned.

To facilitate the execution of the duties assigned to Lieutenant Bache, I have to request that you will, on his making application for the purpose, place a revenue cutter under his control, if one can be spared from its appropriate duties for a sufficient time, for him to examine the coast within

* This report has since been received, and will be found in its appropriate place.
the above limits. If a cutter cannot be spared, you will charter a small vessel, upon the best terms you can, to convey him from place to place, as may be found necessary. You will also provide him with such stationery as he may require.

As it is very important that he should make his report to the Secretary of the Treasury in season to be laid before Congress the first week in their ensuing session, I have to request that you will do all in your power to aid him in the execution of this duty on his presenting himself to you for the purpose.

I have the honor to be, very respectfully, sir, your obedient servant,

A. Gordon, Esq., Key West.
George Bancroft, Esq., Boston.
John Anderson, Esq., Portland, Maine.
Jesse Hoyt, Esq., New York.
Henry Whately, Esq., Wilmington, Delaware.
Conway Whittle, Esq., Norfolk, Virginia.
William Littlefield, Esq., Newport, Rhode Island.

Treasury Department,
Fifth Auditor's Office, August 4, 1838.

SIR: In pursuance of the 3d section of the act of Congress passed the 7th July last, entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838," the President of the United States has divided the Atlantic coast into six districts, and the northern lakes into two districts, for each of which a Navy officer has been designated by the Secretary of the Navy, for the purposes mentioned in the 3d, 4th, and 5th sections of the said act.

The first district on the lakes extends from Detroit to Lake Michigan, inclusive, to which Lieutenant James T. Homans has been assigned.

To facilitate the execution of the duties assigned to Lieutenant Homans, I have to request that you will, on his making application for the purpose, place a revenue cutter under his control, if there be one in your district which can be spared from its appropriate duties for a sufficient time, for him to examine the coast within the above limits.

If you have no cutter, or if you possess one which cannot be spared, you will charter a small vessel, upon the best terms you can, to convey him from place to place, as may be found necessary; you will also provide him with such stationery as he may require.

As it is very important that he should make his report to the Secretary of the Treasury in season to be laid before Congress the first week in the ensuing session, I have to request that you will do all in your power to aid him in the execution of this duty, on his presenting himself to you for the purpose.

I have the honor to be, very respectfully, sir, your obedient servant,

To Edwin Kelso, Esq., Erie, Pennsylvania.
Andrew Mack, Esq., Collector, Detroit, Michigan.
PARIS, August 23, 1838.

SIR: On the receipt of your communication of the 13th July, which I acknowledged from London, I proceeded with all despatch to this city, and, on my arrival here, the 19th instant, was greatly disappointed to learn that Mr. Fresnel was absent, and would not return until November next; but, fortunately, his clerk tendered his services, and recommended me at once to the person employed by the French Government to manufacture their dioptric lenses, with whom I have already contracted for two sets, to be constructed in the best possible manner, and upon the most approved models.

You will perceive by the details of the contract, a duplicate of which is herewith enclosed, that I have been very guarded in binding Mr. Lepaute, by every possible means, in the faithful execution of his work. The machinery of these two sets of lighting apparatus is to be in all respects conformable, in cost and quality, to those manufactured for the French and other Governments; and a sufficiency, to last for years, of duplicates of those parts most likely to be deranged, and of glasses, wicks, &c., is to be furnished by Mr. Lepaute; and, to render it more certain that the apparatus shall be perfect, I have made it a condition that they shall not be paid for until they are approved of by Mr. Fresnel, to whom I have written, requesting him, on his return to Paris, to superintend, so far as his official engagements will permit, the progress of their construction. I have been assured by his clerk, and by Mr. Lepaute, that he would cheerfully do so, and with such authority I have thought myself justified in making the requisite [engagements].

It is the practice with the French Government, as I am informed by Mr. Lepaute and the clerk of Mr. Fresnel, to make advances to the manufacturer as the work progresses; and these conditions are embodied in the contract made by me, a duplicate of which is herewith transmitted, (see 4th, 5th, and 6th articles.) You will notice, however, by the 7th article, that I have made the fulfilment of the 4th, 5th, and 6th articles binding only on the condition of your approval of the terms of payments. I verbally mentioned to Mr. Lepaute that I thought you would assent to the conditions, it being a custom in similar contracts. I should hardly think there would be any risk in paying for these lenses in the manner set forth in the 4th, 5th, and 6th articles, more especially as the work will be done partly under official supervision.

I found that it was impracticable to have those under contract completed before April next, but there is some hope of obtaining one set immediately, which has been finished for the French Government. I have written, at the suggestion of the clerk of Mr. Fresnel, to that gentleman on the subject, and propose to take the set, and to instruct Mr. Lepaute to construct another in its place, of the same cost.

I have ordered one fixed light of the first order without lantern, as the lantern is not considered as belonging essentially to the apparatus, but may be constructed separately, and a revolving light with the lantern. I thought it advisable to procure one lantern as a model by which others may be constructed in the United States. My reason for not ordering lanterns to both, was, that I was fearful that the $15,000
appropriation would be insufficient to pay for these and the set of English reflectors also ordered.

There will be abundant time, however, for you to instruct me on this point, and I would certainly suggest the expediency of ordering both lanterns; one for the fixed light will cost about 13,000 f. I should not have hesitated to order both myself, had I not been apprehensive that you would have been embarrassed in paying more than the sum actually appropriated. You will therefore oblige me by furnishing me with instructions, by return of packet, upon the following points:

Whether I shall agree to the advances as specified in the 4th, 5th, and 6th articles of the contract; and whether I shall order a lantern for the fixed light—a measure I should certainly recommend.

Please to address me, in duplicate, by different conveyances, and direct to the care of the American minister at Paris.

I will communicate with you again in a few days. I am now writing in great haste, having to start to-day on my return to England to complete my duties in that country.

In all my arrangements I have consulted with General Cass, the American minister at Paris, and have left in his hands a copy of the contract with Mr. Lepaute, and duplicates of my instructions from you. General Cass will address a communication to the French Government requesting every facility in aid of carrying into execution the intentions of the law of Congress respecting the lights.

With great respect, I am, sir, your most obedient servant,

M. C. PERRY, Captain, U. S. Navy.

STEPHEN PLEASONTON, Esq.,
Fifth Auditor of the Treasury, Washington.

TREASURY DEPARTMENT,
Fifth Auditor's Office, September 27, 1838.

SIR: I had the pleasure to receive this morning, your letter of the 5th instant, enclosing duplicates of your two letters of the 23d and 28th of August; the one written from Paris, and the other from London. The originals, in one of which you inform me you had forwarded the contract made in France, have not reached me.

I regret that you did not inform me what the cost of each set of lenses would be, so that I could judge whether the appropriation would enable us to procure the lenses, and the two lanterns also. As you have not done so, and we should not be justified in exceeding the appropriation a single dollar, I am constrained to limit your purchase to the two sets of lenses, with the necessary apparatus, and one lantern only. Indeed, the cost of these articles, in all probability, will so nearly approach the limit of the appropriation, as not to leave a sufficient sum to purchase a set of English lamps and reflectors; and if you should find that there will be danger of that, you will omit to procure a set of lamps and reflectors, and confine yourself to the two sets of French lenses and the lantern.
Two thousand six hundred dollars for a lantern (say 13,000 francs) appears to be enormously high, and I feel satisfied that we can make them in this country at a much cheaper rate; and having one to make them by, we can adapt them to the particular towers for which they are intended. Our lanterns, made of wrought iron, with the domes covered with copper, glazed with the best Boston glass, with vane, &c., do not cost more than $800 each.

Although we do not make advances for work done at home, yet, in the case of these lenses, which are made by artists employed by the French Government, you will make such advances, from time to time, as may be necessary to secure a prompt and faithful execution of the work. I should be very glad if you would obtain from Mr Fresnel the lens and apparatus already made for the French Government, paying them for it whatever sum the one you have contracted for will cost.

You will draw for such sum, from time to time, as you may find necessary, on the collector at New York, or on this office, as you may find most advantageous. If you draw on the collector, it ought to be at a sight of ten days; but if upon this office, you may draw at sight.

It would be very gratifying if you could obtain the set already made for the French Government, and send it over to this country in time to try it before the meeting of Congress, as their next session will be a short one, and I should be very glad to have something definite done in regard to our light-house establishment before they adjourn.

I have the honor to be, &c.,

S. PLEASONTON, Fifth Auditor,
and Acting Commissioner of the Revenue.

Capt. MATTHEW C. PERRY.

REPORT OF LIEUTENANT THOMAS J. MANNING.

WASHINGTON, November 16, 1838.

SIR: Having been ordered by the honorable Secretary of the Navy to survey the first district, under the instructions of the honorable Secretary of the Treasury, agreeably to an act of Congress of July 7, 1838, to give direct information in regard to light-houses and light-house system, buoys, &c., I herein send you my report, and give information as far as the limited time would allow.

The sites for buoys and beacons are so numerous on the coast of Maine, and the light-houses so numerous, and many of them out of place, and ought to be removed, that I would respectfully recommend a survey of the whole coast, to begin early in the season, that the surveyors might have all the summer before them, as it would require different views of the lights to determine their proper situation, and would take up much time. Fifteen buoys are now wanted on the Kennebec, and some on the Sheepscot rivers. The "Muscle ridges" also require a strict and careful
survey, that many of the sunken ledges may be buoyed out. This thoroughfare will average twenty coasters per day during the summer season, and some days over one hundred pass through. Many of the other harbors require buoys also.

During my survey of the coast, eight out of nine light-keepers have complained of their oil being thick and burning badly, and I would recommend adopting a different mode to supply that article, which is of high importance to be the best, as the weather is severely cold during the winter season in that climate. Would it not be better if it were purchased by Government, and have a Government inspector, whose duty it should be to supply the oil and examine the lights? This could all be performed by a small vessel, and, I think, much money might thereby be saved to the Government. The collectors, whose duty it is to visit the lights, can perform but one visit a year, and consequently the lights are much neglected for want of strict observation.

* * * * * * * *

I have conversed with many shipmasters on the subject, and found no difference of opinion—that there are too many lights in sight at one time in some places on approaching the coast, and I would recommend that some of them be removed. In two different places on the coast there are nine lights to be seen at one time, which must confuse the navigator. In many other places there are five or six, and sometimes seven lights in sight. It may be that all the lights on the coast of Maine are required, but I should suppose that some of them might be dispensed with. This will require long observation (say the whole season) to ascertain their proper position.

All the lights require distinction. They should be colored or made to revolve, or something to recognize them in a dark night. All this requires much observation, and is of great importance on the coast of Maine. A navigator on this coast is destitute of a correct chart; there is but one, and that is unfinished; it cannot be depended upon; it only embraces the coast of Maine.

I borrowed a chart of the coast from Portsmouth to Salem from a man to whom it was given for safe-keeping. It was the only one to be had. I had it copied. This was a survey made before the Revolution.

The navigator on this coast has much fog and many currents to contend with; therefore the lights and buoys should be so fixed as to be easily recognized, in order to guard against the numerous rocks and ledges which are known to prevail along this coast.

Respectfully,

T. J. MANNING,
Lieutenant, U. S. Navy.

S. PLEASONTON, Esq.,
Fifth Auditor, Treasury Department.
SIR: I have the honor to inform you that, agreeably to the law of Congress, passed July last, on light-houses, light-boats, beacons, buoys, &c., I have surveyed and examined the district assigned me by the Navy Department, from Boston to Newport, inclusive, and report as follows, beginning with Boston light:

**Boston light.**—This light is situated at the mouth of Boston harbor, on a small island called the Little Brewster. It is a revolving light, consisting of 14 argand lamps, with parabolic reflectors, arranged in equal numbers on opposite sides of an oblong-square frame or chandelier, turned by common clock-work. The revolutions occupy 3' 30", during which the combined light of 7 lamps is seen twice from each point of the compass. These lamps are uniform in size throughout the district, and are of about the volume of similar lamps in family use. The reflectors vary from 13 1/2 to 16 inches in diameter.

The keeper of this light complained that his lantern leaked round the lower edges, swilling the deck in frosty weather, causing the clock-work sometimes to stop, when it became necessary to turn the lamps by hand. Various attempts had been made to tighten it, and he now proposed the deck should be coppered.

My attention being drawn to these lanterns, I observed them throughout the district, and found they varied from 5 to 8 1/2 feet high, and from 4 to 9 feet wide.

The use of the lantern being to protect the light, two series being the greatest number in any lantern, and eight lamps with 15-inch reflectors the most in any series, a lantern 6 feet high and 6 feet wide would be large enough to contain the lamps, and afford room for the keeper to attend them.

The frames of these lanterns are of iron; the sash-bars of most of them are 1 1/2 inch wide; styles in proportion; by which a vast portion of the light is intercepted. The glass averages about 10 by 12 square, and is generally full of blisters and waves. Surrounding the lantern is an iron railing, which answers the double purpose of preventing the keeper from falling while cleaning the lantern, and of steadying the lantern firmly in its place. This railing consists of 3 and 4 bars of inch and inch and a quarter iron, also intercepting light. Near the salt air the iron has to be frequently painted, to preserve it from corrosion. This had not always been carefully done, and spots and streaks of paint were sometimes left on the glass. Many of the lanterns are painted black on the inside, and in all instances the chandelier and sheet-iron door were of that color, absorbing light. It will readily be conceived that, under all these disadvantages, however good the light may be in the first instance, it has no chance of presenting a vivid and striking appearance.

With a view to remedy some of these evils, I propose that the lanterns should be made of copper; that the principal strength of them, and also of the railing, should be on the land side, so as to admit of narrow sash-bars and large glass in front, and that the inside should be rendered re-
ffective, by being plated with silver. Such lanterns would be expensive, but, I apprehend, enough money can be saved from the present establishment, without in the least impairing its usefulness, to defray the expense in the course of a few years.

I shall propose a reduction of lamps in nearly all the light-houses in the district. It is certain that many of them have more than is required by the navigation; for instance, Long Island Head light, 4 miles back of Boston light, in Boston harbor, has as many lamps within three as Boston light. All vessels make the port of Boston by Boston light, and the principal use of Long Island Head light is to steady vessels through the rocky passage of Broad sound. A single series of 6 lamps is enough for this purpose. Plymouth lights, which are among the most important on the coast, have but a single series of 6 lamps in each of them, and are seen from Race point, on Cape Cod, a distance of 19 miles. We, ourselves, saw them from the revenue cutter in doubling the cape from Provincetown. Long Island Head light is more elevated than either of Plymouth lights. Barnstable light, 23 miles interior to Plymouth, at the head of Cape Cod bay, has nearly double the number (10) of either of the Plymouth lights. Provincetown Harbor light, standing between Race point and Cape Cod lights, both of which, on account of their elevation, are seen before the Harbor light, has a double series of lamps in it, 6 in the lower and 4 in the upper. On the other hand, Monomoy light, on the other side of the cape, exposed to the open sea, elevated no higher than either of the last two lights, has but a single series of 8 lamps. We saw this light from Nantucket, a distance of 13 miles. All the lights interior to Monomoy, such as Point Gammon, Cape Poge, Holmes’s Hole, and Nobsque, have more lamps and an extra series to that light. All the lights in Buzzard’s bay, except the one at the mouth of the bay, have more lamps in them than is necessary. The little harbor of Metapoiset, at the head of this bay, where a common lantern sufficiently elevated would answer every purpose, is burning 11 lamps, more, with the exception of 5, than any other light-house in the district. To guide vessels clear of the breakwater at Edgartown, 10 lamps have been thought necessary, when surely 4 are abundant. Cape Poge light, 4 miles out, is the guide to the harbor. I shall not propose any reduction in Boston, Race Point, Cape Cod, Nantucket, Gay Head, Cutterhunk, or Newport lights, they being exterior lights and of primary importance. The reductions and alterations which I shall recommend will make a difference of 97 lamps in the district. These lamps cost the Government, for oil, &c., $35 87 1/2 a year, so that the sum saved in this district, without, as I think, impairing the usefulness of the Light-house Establishment, will amount to $3,479 48, sufficient to defray the expense of the proposed lanterns in the course of a few years.

Boston light is elevated 82 feet above the level of the sea, in a stone tower 60 feet high. It must be seen full 20 miles. This tower is finished with wood, as the steps, door, sills, sashes, &c., parts of which are beginning to decay. Many of the light-houses are finished in the same manner. The more modern ones have stone steps, but they have some wooden work about them. I should think it would be easy to avoid the use of combustible and perishable materials about these estab-
lishments. It is difficult and expensive, on account of the remoteness of most of them, to effect repairs; and, by building them in the first instance of the most durable materials, a vast deal of trouble at least would be saved to the Government. The keeper's dwelling here is of wood, and has lately undergone extensive repairs.

This keeper has been permitted to pilot vessels, by which he is frequently absent from home at night. During the first three of the five years he has been here, he realized $150 a year from this business. As this is not the only instance where this practice is tolerated, I suggest whether it would not be better to remove all complaint of inadequacy of salary, as was made by this keeper, and prohibit, by law, all light-house keepers from engaging in any pursuit calculated to absent them from home at the time they are required to prepare, to light, and to attend their lamps.

I visited this light in the middle of the forenoon; preparations had not yet been commenced for the night, such as filling the lamps, burnishing the reflectors, cleaning the glass, &c.; all of which requires to be done every day. As I proceed, it will be seen to what a late hour and under what circumstances this work in some instances was postponed; and I should hope it would lead to a regulation defining the hour, after which, if the light-house were not ready for the inspection of the superintendent, it should be at the penalty of the keeper.

This keeper asked for a boat-house, his boat being in danger in winter from the ice, and suffering in summer from the sun. I should think it would be advisable to have boat-houses in all places where boats were allowed.

*Long Island Head light.*—This is a fixed light on the northern extremity of Long island, harbor of Boston. Its principal use, as I have stated, is to light vessels through Broad sound. There are now 11 lamps in it, with $\frac{13}{2}$-inch reflectors. I recommend the suppression of 5 of these lamps and the arrangement of the remaining 6 in a circular form, so as to suit the entire navigation of the harbor. I also recommend that the reflectors be removed, in order that the light on the opposite side of the circle, as well as that on this side, be seen from every point of the compass. Where the lamps are in segments of circles, or in planes, it is well to have reflectors, because then the escape of any of the rays in the direction they are not wanted is to be prevented. Short chimneys or tube-glasses have been used here, allowing the flame of the lamp to deface the reflectors. This is the case, more or less, in nearly every light-house in the district. The semi-diameter of the reflectors being greater than the length of the chimney, the flame, instead of being carried above the edge of the reflector, has come in contact with it. In winter longer chimneys are used, so as to reach to the metallic conductors, (or heaters, as they are called,) which are inserted in the fountains for maintaining the fluidity of the oil. The additional heat from stoves is sometimes necessary to this purpose. I apprehend, if the lanterns had no doors or ventilators in them, like that at Gay head, their temperature could be maintained without at least the aid of stoves. At Gay head all the draught comes through the scuttle which leads into the lantern, and the keeper, instead of passing through a door in the lantern to the gallery,
ascends thereto through a separate scuttle in the top of the tower, exterior to the lantern.

This light is 80 feet above the level of the sea, in a stone tower 20 feet high. I have based the reduction of this light on those of Plymouth and Monomoy, which are in single series, and confessedly answer all the purposes of commerce and navigation.

Conveniently for the keeper, the tower and dwelling are contiguous; so that in stormy weather the light may be attended without exposure. It is to be regretted that, in many places where it might have been the case, this arrangement has not been observed. Oftentimes, in sickness or absence, the wives or children of the keepers have to attend to their duty, when it becomes an object of great importance to the public that no dread of the weather should deter feeble or tender persons from visiting and trimming the lamps at the appointed hours. There are 5 beacons and 25 buoys in this harbor, all of which are indispensable to the ease and safety of navigation. The beacons are in sufficient preservation, and the buoys are attended to by a person appointed for that purpose, who replaces them whenever they are drowned or adrift.

Scituate light.—Twelve miles to the southward of Boston light, on Cedar point, at the entrance to Scituate harbor, stands Scituate light. This is a double light in a single tower; the lower light red, the upper white. It is not apparent why this should be a double light, when a single one would answer all the purpose. There is no other red light in Boston bay, so that, by having this a single red light, it is not possible it should be mistaken. Accordingly, I recommend its conversion into a single red light. There are now 15 lamps in this light—8 in the red and 7 in the white. The red light has reflectors 15 inches in diameter, the white only 8½. The red light is made by a separate sash with colored glass, placed against the windows, so that the light has to pass through two thicknesses of glass. The colored glass is cracked, and not uniform in color, and the outside glass is of an inferior quality; the sash-bars intercepted three times as much light as they should do. I removed the colored sash, and found the outside glass to be detrimental; objects seen through the colored glass, singly, showing plainer than when seen through the two. The upper lantern, besides being of the massive strength common to others, is glazed with the most inferior glass in the district. I visited this light in the middle of the forenoon; the keeper absent, to be gone until the middle of the afternoon; not a lamp touched, the reflectors looking as if they had not been burnished for a length of time, and the glass smoked. Perhaps no place on the coast requires a better light than Scituate; not so much on its own account, for the port is small, and cannot have much trade, but on account of the navigation between it and the mouth of Boston harbor. Directly in the way of the whole coasting-trade of the south shore, and not far from the track of vessels bound in from sea, lies Minot's ledge, reaching nearly two miles into the bay. This is only about five miles from Scituate, so that a good light there would help to prevent some of those numerous and fatal accidents which have befallen vessels on this ledge. Arranged as the lights now are, the lower one only twenty feet above the level of the sea, and made in the manner it now is, it is not possible they should be of much
service. To know them, you must approach near to them; for, being only fifteen feet apart, they blend at a short distance, and appear like a single light. Every consideration urges the conversion of this light into a single one of a distinguishable color; for, as I have said, there being no other red light in the bay, it is not possible it should be taken for any other; and having fifteen feet more elevation, it will be visible so much the farther. If to this be added the improvement which can easily be made in the manner of exhibiting the red light, I doubt not more assistance will be received from it than has hitherto been experienced. The seven lamps now in the upper light would be all that would be required under the change, occasioning a difference of $286.96 a year in the maintenance of this establishment.

The original tower here was of stone, to which a brick addition has been made, probably at the time the extra light was made. It is very much out of repair, and requires immediate attention to the wooden work. The dwelling is of wood—an old, thin, badly-built house. It would be advisable to erect a new dwelling of brick or stone contiguous to the tower. The keeper, at his own expense, has been allowed to build an addition to the Government dwelling. I mention this, not only as it is without precedent, but because the keeper has the reputation of trusting the care of the light to his tenant, which may be one reason, among others, why this light has such a low reputation.

_Plymouth lights._—Thirteen miles farther south, on Gurnet point, at the entrance to Plymouth harbor, stand Plymouth lights. These lights are different again, being horizontal. They require to be double, to distinguish them from the single light of Barnstable. They are in two separate towers, 22 feet high, and 30 feet apart. They consist, as has been stated, of a single series of six lamps each, with old 8½-inch reflectors, arranged in a circular form, so as to suit the harbor as well as sea navigation. Their elevation is 70 feet above the level of the sea, enabling them to be seen, as has also been stated, all the way across to Race point, a distance of nineteen miles.

The objection to these lights are, that they are too near together, by which they blend, and appear single at a short distance; and that, being horizontal, they are liable to come into a range with each other, by which, also, they appear single. It is but a few years since a vessel was lost to the northward of them, the captain protesting that but one tower was lighted, by which he was deceived. Both towers were lighted, but one concealed the other, so that but a single light appeared.

I propose to remedy one of these evils, and modify the other, by converting this from a horizontal into a perpendicular light, and erecting a new tower 60 feet high. Then, as the ground is 50 feet high, the lower light might be fifteen feet from the base of the tower, which would give it an elevation of 65 feet above the level of the sea; and the upper light being forty-five feet above it, (one-half farther that the lights are now apart,) the objection to their blending would be greatly modified, and the evil so much complained of effectually remedied. The tower would not be higher than three now in the district. The present towers are of wood, and somewhat decayed, so that it would not be much of a sacrifice to demolish them. The same number of lamps would answer for the new
tower. In the event of a new tower being built, I recommend that the lower lantern be supported exterior to it, a door from the tower leading into the lantern; which would obviate any objection of intersecting and weakening the tower with a large window. The single light at the top would be all that would be required for the harbor navigation. I recommend, too, (what I have not yet seen,) a cellar under the tower, for the warm as well as safe-keeping of the oil; and as the present dwelling is of wood, and but an inferior building, I suggest whether it would not be advisable at once to give permanency and durability to this important establishment by the erection of a new dwelling, as well as tower, of brick or stone. The ground admits of their being contiguous; and it is to be hoped, should these alterations be made, the comfort and convenience of the keeper, as well as the good of the public, will be considered in this particular. I might remark that the lanterns on these towers are of the same very objectionable description heretofore represented.

There are two beacons and two buoys in this harbor, judiciously placed, and in good order.

_Barnstable light._—Twenty-three miles farther to the southward, at the head of Cape Cod bay, stands Barnstable light. This light is on a low, sandy point, at the entrance to the harbor, elevated 25 feet above the level of the sea. It consists of ten lamps, with 14½-inch reflectors, arranged in two series or tiers, the lower containing six, and the upper four lamps. I recommend the suppression of the upper tier. It cannot be that this light requires more lamps than either of the Plymouth. Those lights are far outside of this, more exposed, and with a vastly heavier trade dependent upon them. No vessel can well approach Barnstable without having seen either Plymouth lights, the lights on Cape Cod, or Billingsgate light, so that she cannot navigate but a short distance before she meets with this light. Monomoy light, on the other side of the cape, open to the ocean on one side, and to the shoal navigation between Nantucket and the main on the other, has but a single series of lamps. I can have no hesitation in urging the reduction of this light, as I have that on Long Island head, and as I shall many others, convinced that their position neither requires nor justifies the expenditure of so much money in their support. The remaining series will be benefited by a more compact arrangement. Throughout the district, proper regard has not been paid to this particular. The lamps vary from 1 to 17 inches apart; one effect of which is to weaken the light, and another to inconvenience the keeper. In the event of improved lanterns, of a uniform size, being substituted, it would not only be necessary, but advantageous to every light in the district, to undergo a careful and compact rearrangement.

This light is on the keeper's dwelling, which is of brick, with a wooden tower rising from the centre of it. This is an exceedingly injudicious arrangement, for, if any accident from fire happens to either, both are liable to be destroyed. I should think, in all instances where it could possibly be done, it would be preferable to have the buildings distinct; or, if they were united, composed, at least, of incombustible materials. The premises here are in good order.

There is one buoy belonging to this harbor important to the navigation.

_Billingsgate light._—Fifteen miles from Barnstable, along the western
shore of Cape Cod, at the entrance to Wellfleet bay and harbor, stands Billingsgate light. This is a useful light to this navigation. It is larger, however, than is necessary. There are eight lamps in it, with $13\frac{1}{2}$-inch reflectors, in two equal and parallel series. Race Point light is but $15$ miles off; afterwards Provincetown Harbor light has to be passed; and if vessels come from the south shore, they can make but a short run before they arrive at this light, which is forty feet above the level of the sea. I doubt not one of the present series would be sufficient, but I shall recommend six lamps, suppressing two as entirely superfluous. The six to be compactly arranged to suit the navigation.

I visited this light in the afternoon, and found the keeper absent to a distance, without having first prepared his lamps, reflectors, and glass for the night. Indeed, the reflectors had the appearance of not having been burnished for some time.

Premises in sufficient order.

There is a rock to the eastward of this light, directly in the channel-way of the harbor, called Channel rock, which has damaged many vessels. Agreeably to the wishes of the people of Wellfleet, and in accordance with my own judgment, I recommend a buoy for this rock.

I was surprised to find a light-house building on Mayo's beach, at the head of this harbor, and wrote to you in hopes of arresting the work.

This harbor is but about four miles long, and when vessels get within Billingsgate light they are as safe as they can be in any part of the harbor. I inquired of the people of Wellfleet the necessity for this light, and the only advantages they promised themselves from it were, in "running a straight course over the flats at high water," and "seeing the shore in winter when the snow was on the ground." This harbor, as I am informed, is frozen over most of the winter, the sea not having in with sufficient violence to break up the ice after it is once formed; and when the tide will admit of a straight course being made up the harbor, it can as well be done by compass as by a light. At other times, the channel is too narrow and intricate to render a light of much use, except at intervals. Some venerable old fishermen and pilots belonging to the place, whom I also consulted, declared their opinion openly and publicly against the light; and elsewhere on the cape, when this light was mentioned, it raised a smile. Should Government, however, continue of opinion that a light is necessary in this place, then I recommend it should be a tide-light, to consist of one lamp, to be lighted an hour before, and kept lit an hour after high water. But, according to my judgment, it should be entirely suppressed.

Provincetown Harbor light.—Ten miles further along the cape is Provincetown Harbor light, situated on the point of a long, low sand beach, which forms one side of the harbor of Provincetown. This is an exceedingly useful light, but far larger than is necessary. It is so situated that Race Point and Cape Cod lights are seen first in making the harbor; consequently, it requires not to be much elevated, or of much power. It is on the keeper's dwelling, 28 feet above the level of the sea, and consists of 10 lamps, with 15-inch reflectors, in two series, 6 in the lower and 4 in the upper. I recommend the suppression of the upper series, and the compact arrangement of the lower, to suit the navigation.
The same great objections exist to this as to the other lanterns.
This house was in danger from the sea until Government built a ledge, or breakwater, outside of it; since which, the keeper and his family have experienced less anxiety for their safety.

Race Point light.—This point is situated five miles to the northward and westward of Provincetown light, on the extreme point of Cape Cod. It is a revolving light, on the same plan as the Boston light, consisting of 10 (as that does of 14) lamps. The reflectors are 13 inches in diameter. This light is 30 feet above the level of the sea, in a stone tower 20 feet high, and is always seen, in good weather, from Gurnet point, Plymouth, 50 feet above the level of the sea—a distance, as has been stated, of 19 miles. Its location renders it a light of great value and importance to the navigation of Boston bay, and to vessels arriving from sea; consequently, I have not thought of proposing any reduction to it. I visited it near the middle of the forenoon, and met the keeper absenting himself from home without having guarded against detention by preparing his lamps, reflectors, and glass for the night. They were, however, in such order as to induce favorable impressions of the manner in which the light is kept. The tower and dwelling are of stone, judiciously connected together by the kitchen, which has been lengthened for that purpose. One hundred and fifty dollars have just been appropriated for reshelving the roof of the dwelling, which gives me an opportunity to repeat upon the more durable as well as safer materials for such purposes; this, for instance, being one of those remote situations where repairs are liable to be unskilfully as well as expensively done.

Cape Cod light.—This great and important light stands nine miles to the eastward of Race point, on the high land of Truro, 160 feet above the level of the sea. It consists of 15 lamps, with 15-inch reflectors, in two circular series, 8 in the lower and 7 in the upper. These lamps are so arranged as to be seen from Boston bay as well as the sea. I noticed one of the lamps, in the lower series, to be fronting the iron door of the lantern; of course, to no useful purpose. It should be removed to the upper series, where there is room enough for it. These reflectors are from one to two inches apart, while (without any apparent reason for it) there are ten inches between two of them. I recommend, as at Long Island head, the removal of these reflectors, so that all the lamps in the lantern may be seen from all points of the compass—an effect which cannot be produced while the reflectors intercept the light of half the lamps.

I visited this light a few minutes before sundown, and found the keeper (alarmed at the sight of the revenue cutter) stolen into his lantern to make a hasty rub-up against the expected visit. Time did not admit of the necessary preparations being made before the hour of lighting. But few of the lamps were trimmed. Such chimneys as had been touched were imperfectly cleaned. The reflectors had no appearance of having been recently burnished, and the glass of the lantern was smoked. This light, on account of its magnitude and elevation, would, if properly kept and attended, illuminate this whole coast all the way down to Chatham, a distance of 25 miles; at all events until it intersected that light, which is itself 70 feet above the level of the sea.
This tower is of brick, 30 feet high. The walls, at the base, are 3½ feet thick—one-third more than the walls of the stone tower at Clark's point, which is 10 feet higher. The interior width at the base is 15 feet, two feet more than that tower. The finishings (as steps, doors, sills, &c.) are of wood, exhibiting, though only built seven years, some signs of decay.

This lantern is eight feet high, two feet higher than is necessary. The glass, 12 by 14, is of a better quality than any yet observed. Premises in good order.

_Nauset lights._—Half-way between Cape Cod and Chatham lights, on the table land of Nauset, have just been erected three stone towers, 15 feet high and 150 apart; each containing 10 lamps, with 13½-inch reflectors. This is a clean, bold, regular coast; no port to be guided into by these lights, making it difficult, at first, to comprehend their use. Never having, before, seen any similarly located, I found it difficult to reconcile myself to them on any terms. They were, doubtless, given this triple appearance to distinguish them from Chatham lights, consisting of two towers similarly arranged. Nauset beach has always been considered a dangerous place for vessels, and many have been wrecked there. To guard against such disasters seems to be the object of these lights. I cannot, however, think that three lights are at all necessary. Any single distinguishable light that can be seen eight or ten miles will answer every purpose. Such a light is a revolving red light. There is no revolving red light, that I know of, on the coast, so that accidents could not possibly occur from its being mistaken. The shape of the coast and the nature of the navigation is such, as will be seen by the chart, that if a vessel can but see a light six or eight miles, be the wind as it may, she can either fetch round Cape Cod and be safe, or make Nantucket light, and secure herself behind that island; and for determining her position on ordinary occasions, such a light would be just as useful as any number of any other kind or color. I cannot believe that the Government will consent to consume 900 gallons of oil, when 300 or 360 will answer every purpose. Accordingly, I shall recommend the conversion of these lights into a single revolving red light; and as red is a color which does not show so vividly as white, instead of 10, (the number of lamps at Race point,) there should be 12 in this light. I have had no opportunity of ascertaining the character of but two of our red lights—the Scituate, and one at Norwalk, in Long Island sound. The first never can be of much use to the navigator, owing to its elevation, but principally on account of the very objectionable manner in which it is made. The latter, as I am informed by pilots, coasters, and steamboat captains, answers admirably all the purposes for which it was designed, and is constantly visible from 10 to 15 miles. Of course, I can have no hesitation in proposing that color for Nauset.

These lights have not yet been lit; but the keeper is in momentary expectation of receiving the oil for that purpose.

I could see no improvement in these lanterns, except that the glass was of a better quality. Their principal strength might have been on the land side, so as to have had the front almost entirely transparent; preventing thereby the interception of a tenth or more of the light.
The number of these towers, the distance they are apart, and the equal distance the dwelling is from them, justify the belief that a single light, distinguishable from all other lights on the coast, contiguous to the keeper and his family, would render more service than they to the navigation.

Chatham lights.—I pass to Chatham lights, 13 miles to the southward. These lights were originally intended to guide vessels across Chatham bar, which filled up many years ago; since which, their use has been to warn vessels off the coast, (same as that proposed by Nauset lights,) but principally to assist the pilots and coasters in navigating past Pollock rip, a dangerous shoal making off from Monomoy or Sandy point, at the entrance to the shoal and intricate navigation between Nantucket and the main land. I should propose the suppression of these lights, were it not that they are auxiliary to Nauset, and, from long habit, in a measure necessary to the pilots. Their conversion, however, to a fixed red light will be urged, making a difference of one-half the expense in their maintenance. A single fixed red light here can never be mistaken, can never create the least embarrassment or confusion. There is no such light anywhere along the coast. The revolving red light of Nauset cannot, of course, affect it; and if a vessel were accidentally to pass Cape Cod, and fall in upon Scituate, (recommended to be a single red light,) supposing herself off Chatham, she could steer in no direction without instantly discovering her mistake, and being safe. With a fixed red light at Chatham, and a revolving light of the same color on Nauset, the coast will read thus: Beginning at Sandy point, where stands Monomoy light; a fixed white light at Sandy point; a fixed red at Chatham; a revolving red on Nauset; a fixed white at Truro; and a revolving white at Race point. It is not possible this language should be misconstrued; and then the coast is lighted, and well lighted, at a saving of lamps enough for four ordinary light houses.

The present towers at Chatham are of wood, very much shaken and decayed, so as to make it dangerous to ascend them in windy weather. They each contain 6 lamps, with $8\frac{1}{2}$-inch reflectors, and with plano-convex lenses of green glass, nine inches, in front of them. The reputation of this light is very low, owing, however, I apprehend, principally to the very neglectful manner in which they have been attended. I visited them late in the afternoon, and found them in as bad order as they well could be—nothing done to them from the previous night; the reflectors, apparently, not having been burnished for a length of time; the glass very smoked, and the lamps neither filled nor trimmed. A sly attempt was made by the keeper to have them prepared through his son; but what were partially done only served to show more plainly the condition of the remainder. If there can be any excuse for this keeper, it is in the dilapidated condition of these towers, requiring a severe tax upon the pride he may possess for a faithful discharge of his duty.

The dwelling here is very much like that at Scituate, but smaller, and less commodious. Of course, it will be no sacrifice to demolish both dwelling and towers, and erect an entirely new establishment of brick or stone. I recommend the site of the southernmost of the present towers for the proposed one, and the number of lamps (six) now in that tower
for the light. The saving in oil, &c., will be $215 25 a year, a sum sufficient to defray the expense of these improvements in the course of not many years.

Monomoy light.—This memorable light stands on Sandy point, eight miles from Chatham, a long, low beach that reaches off right into the very heart of the whole coasting navigation, and requires to be lighted, perhaps, more conspicuously than any other part or point in the district. This light, on the keeper's dwelling, elevated only 25 feet above the level of the sea, has but a single series of lamps, while almost every other light in the district (most of them more elevated and interior to this) has a double. I acquainted myself with the reputation of this light, and found it perfectly satisfactory and good. I myself saw this light from Nantucket, 15 feet above the level of the sea, a distance of 18 miles. If, then, a single series of lamps be sufficient here, much more is the same arrangement justifiable at those places already mentioned, and at such as will hereafter be described. The navigation requires these lamps to be arranged nearly in a circle, causing the light of the lamps on the opposite side of the circle to be intercepted by the reflectors; consequently, it would increase the strength of this light to remove those obstacles. But if the reflectors remain, they should be rearranged nearer together, there being now spaces of from two to five inches between them. There are 8 lamps here, with 13-inch reflectors. Premises in sufficient order.

This point of land has received an accession of several hundred yards from the sea, making it probable that, in the course of a few years, when the land shall have formed a little higher, it will be advisable to remove this light farther to the southward.

Back from Sandy point, half way between Chatham and Hyannis, there is a wooden beacon on Dog-fish bar. This beacon requires to be painted black, to render it more conspicuous.

Government is running a breakwater from this beacon parallel to the coast, the utility of which may be questioned from the fact that a hole, about a third of a mile inside of this breakwater, (called, by comparison, the deep hole,) has, within a few years, filled up with sand and become a flat.

Point Gammon light.—Twelve miles to the northward and westward of Monomoy light, off the harbor of Hyannis, stands Point Gammon light, in a stone tower 70 feet above the level of the sea. This light consists of 10 lamps, with 13½-inch reflectors, in two series or tiers, 6 in the lower and 4 in the upper. We are now where lights are very important, but they are near together, and do not require much elevation or size.

This light will be abundantly conspicuous with a single series of lamps. Accordingly, I recommend the suppression of the upper series as not required by the navigation. The remaining 6 lamps require to be more compactly arranged, there being between 4 and 5 inches between each of the reflectors.

The dwelling, which, like the tower, is of stone, is judiciously connected with the tower by the kitchen, enabling the keeper to attend the light without exposure to the weather.
Premises have just undergone repairs, and are in good order.

Seven miles to the southward and westward of Point Gammon, on a ledge of rocks stretching between two and three miles into the sound, called Collier’s ledge, there is a beacon in sufficient preservation.

I may here remark, that there are 22 buoys on the shoals between Nantucket and the main, all of which are judiciously placed, and very necessary to the ease and safety of the navigation.

*Edgartown Harbor light.*—This light is on the keeper’s dwelling, at the end of a short wooden breakwater in the harbor of Edgartown. Cape Poge light, 4 miles outside, is the guide to the harbor, so that the light on the breakwater requires to be of very little magnitude; yet I found the same number of lamps burning here as in the most exposed situations in the district. It is true only 7 of the 10 were fronting the sea, the other 3 being so placed as to reflect their light, to no useful purpose, towards the shore. I recommend the suppression of 6 of these lamps, and the compact arrangement of the remaining 4 to suit the approach to the breakwater. In case it should be objected that this light, not being large and striking, might not be sufficiently contrasted with the lights on board the shipping and on shore, red chimneys or tube-glasses might be used, a mode of making colored lights only exceptionable from the liability of those articles to break, when a white light would, of course, be reflected. It cannot be long before Government will have to reconstruct this breakwater and light-house, as the worms have made great havoc with them, and the sea threatens them, particularly the latter, with total destruction. When that time shall arrive, I recommend the permanent conversion of this light to a red one, consisting of the present proposed number of lamps.

Every proper attention has been paid to the preservation of this establishment.

There are 3 buoys and a spindle in this harbor, all of which are judiciously placed, and necessary to the navigation.

*Cape Poge light.*—This light is on the eastern entrance to Edgartown harbor, 55 feet above the level of the sea. They were in the act of moving the tower (which is of wood) a few yards back, the sea threatening to undermine it. This is an exceedingly useful light, not only as a guide to Edgartown harbor, which is the resort of an immense number of vessels, but to the trade entering the “shoals” from the southward, and to vessels crossing them in all directions. It, however, is of no more importance than Monomoy light, and, being twice the elevation of that light, requires less a greater number of lamps; besides, it requires not to be seen from as many points of the compass as Monomoy, consequently, fewer lamps in the series will answer for it than for that light; accordingly, I recommend the suppression of the upper series, consisting of 5, and the more compact arrangement of the lower, consisting of 6 lamps. The reflectors are 13-inch. The dwelling here, as well as tower, is of wood. The tower is 40 feet high, and, not having been built sufficiently strong, has suffered from the action of the wind. It will, however, last for many years, though, when the time arrives for rebuilding it, advantage ought to be taken of the present site for the use of more durable materials. Premises in sufficient order.
Light-boat on Cross rip.—Nine miles to the eastward of Cape Poge, half way between Horseshoe shoal and Long shoal, in the great thoroughfare of most of the coasting and much of the foreign trade, lies moored a light-boat. This boat is not only invaluable as a beacon by night, but she is of immense use as a buoy by day. Last year 10,518 passages were made in sight of her, besides those that must have profited by her light without being seen by her. This light consists of a single common lamp with ten wicks, elevated sufficiently high for the navigation. I found the boat in good order, except that she had no spare cable and anchor in case of accident to her present moorings.

Nantucket Harbor light.—This light is on the keeper’s dwelling, on Brant point, at the entrance to Nantucket harbor. It consists of 8 lamps, with 12½-inch reflectors, in 2 series—6 in the lower, and 2 in the upper. The upper lamps are entirely superfluous, and may with perfect propriety be suppressed. Indeed, I have reason to think that one-fourth the number of lamps, differently attended, would give more light; for, in the middle of the afternoon, (the keeper absent, to be gone until sundown, the hour of lighting,) I found the lantern smoked, tube-glasses the same, lamps not trimmed, and reflectors really looking as if weeks or months had elapsed since they had been cleaned, they were so black and spotted. The premises are in sufficient order.

Back of this light, at the head of the harbor, stands Nantucket beacon, so placed as to range with the harbor light in guiding vessels across the bar. This beacon is a small building 11 feet high, in the window of which are two common lamps—one with three, the other two wicks. Very little attention had been paid to the neatness and cleanliness of this little establishment; the lantern in which the lamps are placed being exceedingly filthy, and one of the squares of glass, directly at the side of the light, out; some rags braced in its place with a stick. Two beacons, similar to this, are building at the head of Brant point, opposite to the best water on the bar, which will not, however, supersede the necessity for the present lights, the channel being intricate and narrow, and the depth of water so small as to require the utmost aid from buoys and lights to vessels in picking their way into the harbor. Finding an extra dwelling erecting near these beacons, I took occasion to suggest whether the keeper of the harbor light could not attend them, as the keeper of the old beacon informed me he had had no trouble for the 11 years he had been there, but to light the lamps at sundown and extinguish them at daylight, they always burning steadily through the longest night; and it is farther from that keeper’s dwelling to the old beacon than from the harbor light to the new beacons. There are four buoys and a buoy-boat on Nantucket bar, all of which are required by the navigation.

Nantucket great light.—Seven miles from Nantucket harbor, on the northern extremity of the island, stands the great light of Nantucket. This light is 70 feet above the level of the sea, in a stone tower 60 feet high. It consists of 14 lamps, 3 with fifteen and 11 with sixteen-inch reflectors, arranged in the usual way, in two circles parallel to each other and to the horizon. The keeper has removed 7 lamps from the chandelier, and placed them on a shelf against the window, on the familiar principle
of doing the same when we would throw a light into the yard. I confess the lamps against the window seemed to show with more power than those back upon the chandelier near the centre of the lantern. The principal advantage he hopes to derive from this arrangement is in the prevention of frost on the glass by the heat of the lamps. The objection to this plan is, that the attendant, standing in the centre of the lantern, will have the reflectors between him and the light. If he should have trimmed the lamp too much or too little, he may not discover his mistake before leaving the lantern; whereas, now, he passes round the lamps, in view of them, and may readjust any that happen to smoke or do not burn sufficiently high.

The reflectors on this chandelier are from 10 to 17 inches apart. I recommend their removal, that, as the light requires to be seen nearly all round the compass, no portion of it may be intercepted by the reflectors.

This lantern is 8½ feet high and 9 in diameter, very nearly one-half larger than would be necessary were the lamps compactly arranged. The tower and dwelling are connected by a short covered way, which, among these sand hills, where the snow must drift in winter, is a security that the light will be well attended.

This being an exterior and important light, I propose no reduction of it. Premises in sufficient order.

Holmes’s Hole light.—I return to Martha’s Vineyard, to the light at the west chop of Holmes’s Hole harbor, 9 miles to the northward and westward of Cape Poge, and 4 miles to the southwest and eastward of Nobsque light. This light is in a stone tower, 25 feet high, and 60 above the level of the sea; it consists of 10 lamps, with 13½ and 15-inch reflectors, arranged in two equal series or tiers. Though an exceedingly useful light, six lamps, compactly arranged in a single series, are a abundance for it. I found this light in admirable order; reflectors bright, glass perfectly clean, lamps carefully trimmed, and everything justifying the high reputation it enjoys along the coast.

The sea is encroaching upon this tower and dwelling, and, in the event of its becoming necessary to remove them, I recommend that the light be placed about three hundred yards farther to the southward, on a site much approved by the pilots, directly opposite a shoal on which vessels are apt to strike, supposing that after they have passed the lights, to enter the harbor, they are out of danger. No less than 127 vessels have been ashore here during the twenty years this keeper has attended the light. It might be necessary to raise the tower a few feet, so that the light could be seen along the passage between the shoal called the Middleg round, and the western shore of the island. Premises in good order. There is one buoy in this harbor.

Nobsque light.—Across Vineyard sound, at Wood’s Hole harbor, stands Nobsque light, on the keeper’s dwelling, 80 feet above the level of the sea. This light, rivalling in neatness and reputation the last mentioned, consists of the same number of lamps and sized reflectors; arranged, however, in the usual manner of six in the lower, and four in the upper series. I regard the upper lamps as entirely superfluous. This light, though useful, requires to be seen only for a short distance, other lights
being near to it; and no reason in the world can be given why it should have an extra series to lights in far more exposed situations. The remaining six lamps should be brought into a more compact form. Dwelling of stone; premises in good order.

This keeper has heretofore been allowed a boat, but he informs me a new regulation excludes him, in common with other light-keepers living on the main, from that allowance. Should the regulation be waived in favor of any one, I hope it will be extended to this individual, who once had it in his power, with the Government boat, no longer serviceable, to rescue some persons from drowning.

There are six buoys in this harbor, and nowhere are buoys more needed; for here the tide rushes through between Nashawn island and the main, making them of great use to the navigation.

**Tarpaulin Cove light.**—Seven miles to the southward of Nobsque light stands Tarpaulin Cove light, on the southern entrance to that harbor. This light is the same height above the level of the sea as Nobsque light, in a stone tower, twenty-five feet high. It consists, too, of precisely the same number of lamps, similarly arranged. Vineyard sound is here five miles wide; Gay Head light is nine, and Cutterhunk light twelve miles distant, each containing the same number of lamps as this light. They are exterior lights, sea as well as coast lights. This is an inland light, as are all the lights between them and Monomoy light; of course, it cannot require to equal them in magnitude. I must continue to recommend the reduction of these lights to the wants of the navigation. A single series of six lamps, compactly arranged, is abundant for Tarpaulin cove. The reflectors here, as in almost every other light, have been defaced, as was before stated, by the use of short chimneys. The lanterns, too, continue of the same massive description, with exceedingly inferior glass.

This tower requires repairs in the wooden work. The dwelling, too, which is also of stone, is defective. In the event of an improved lantern being placed on this tower, I recommend that advantage be taken of the opportunity to raise the tower about fifteen feet, so that the light may overlook the ground immediately to the southward of it, and accommodate vessels coming along the eastern shore of the island. There is one buoy in this harbor.

**Gay Head light.**—This is a revolving light, at the entrance to Vineyard sound, on the western extremity of Martha's Vineyard island, 160 feet above the level of the sea. It is of the same size, and on the same plan (except that it revolves in four, instead of three and a half minutes) as that at Race point. These reflectors have been much injured by the use of short chimneys. The pilots inform me that this light is constantly seen by them upwards of twenty miles; being one of the exterior line of lights, it admits not of the least reduction. This lantern is seven feet high and seven wide, larger than is necessary, and has inferior glass in it. The tower, which is of wood, has lately undergone extensive repairs, during which the light was suspended. It strikes me that the interests of commerce would justify the erection of a temporary building in such cases. Where it was a fixed light, nothing would be easier than to
perpetuate it in such a lantern as is used in the light-boats, sufficiently elevated for the purpose. Premises in good order.

Cutterhunk light.—This light stands on Cutterhunk island, and is a guide both to Buzzard’s bay and Vineyard sound. It is forty-eight feet above the level of the sea, in a stone tower twenty-five feet high, and consists of the usual number of ten lamps, with thirteen-inch reflectors, arranged in two unequal series, (six in the first, and four in the second,) parallel, as has been repeatedly described, to each other and to the horizon. I found the lights in the middle of the forenoon prepared for use, but in a manner showing the necessity for a more rigid superintendence. The reflectors were cleaned in the too ordinary acceptation of the term. Instead of being burnished with whiting, as they require to be, every day, the smoke of the preceding night had merely been wiped off them. Not even so with the lantern, which, besides, was suffering seriously in the frame from corrosion. This is one of those lights that require to be of extraordinary magnitude, and to be well attended. I recommend no other alteration in it except a more compact arrangement of the lamps, and, in common with the rest of the district, a more suitable lantern.

This tower was originally of stone, but was so badly built as to require twice to be encased in brick. It has at length been rendered impervious to the weather, and now answers the necessary purpose. The dwelling is of stone, and is in sufficient order.

Dumpling Rock light.—Nine miles within Cutterhunk light, on the opposite side of Buzzard’s bay, stands Dumpling Rock light. This light is insulated a few hundred yards from the main land, and is on the keeper’s dwelling, forty-three feet above the level of the sea. It is a useful light in guiding vessels into Dartmouth harbor, and in enabling them to avoid the dangers of this immediate navigation; but, like most of the lights in this district, it is much larger than is necessary. There are the same number of lamps in it, with fourteen-inch reflectors, that are in the exterior light of Cutterhunk; one of the lamps is reflecting the light to no useful purpose towards the shore. I recommend, strenuously, the suppression of the upper lamps, and a compact arrangement of the remaining six. They are now seven inches apart.

I visited this light in the afternoon, and found the keeper absent on the main, without having paid the least attention to the lamps since he extinguished them in the morning. The reflectors appeared not to have been burnished for some time, and the lantern was covered with smoke.

This keeper and his family were in danger of being drowned out, until Government built a wall round the dwelling; since which, they have lived in safety. Located as this light is, on a small barren rock, with fewer advantages to the keeper than, perhaps, any other light in the district, it would seem proper that I should notice the fact of the salary being smaller by $50 than that of many others.

Clark’s Point light.—Four miles above Dumpling Rock light, on the same side of the bay, at the entrance to New Bedford harbor, stands Clark’s Point light. This light is fifty feet above the level of the sea, in a stone tower forty-two feet high. Here, again, though advancing up the bay, among familiar soundings, we have the same number of lamps
as at Gutterhunk. Doubtless four lamps, properly attended, would be abundant here; but I shall recommend six, suppressing the upper tier as being entirely superfluous, and not required by the nature of the navigation. I visited this light in the forenoon, and have good reason to think that fewer lamps, differently attended, would afford equal light; one of the lamps was without a fountain, and appeared not to have been used the previous night. Two of the chimneys, or tube-glasses, were broken, and some of the others so much smoked as to show that they had been carelessly trimmed. The reflectors were not bright, and did not appear to have been recently cleaned.

The Government have no dwelling here, the keeper occupying his own house. There are three buoys and a beacon belonging to this harbor; the beacon has lately been erected, and would have been more serviceable to the navigation, had it been placed about 150 yards farther to the southward, directly on the southwestern point of Egg Island shoal.

Ned's Point light.—Ascending Buzzard's bay, six miles to the northward, we arrive at the retired little harbor of Metapoiset, where stands Ned's Point light. This light has recently been erected, and consists of eleven lamps, with thirteen-and-a-half-inch reflectors—six in the lower, and five in the upper tier. The bay is here about seven miles wide. Three miles to the northward stands Bird Island light; the lights down the bay have been stated. Much of this navigation is aided by Nobsque light, which, though standing on Vineyard sound, is seen from the bay. Metapoiset is a place of little or no resort, except for its own trade, which is small; consequently, there are many nights when a light is of no use whatever in this harbor; yet we find more lamps here than in three-fourths of the light-houses in the district. I have elsewhere remarked, that a single common lantern, sufficiently elevated, would answer all the purposes of this navigation; whereas, now, between three and four hundred gallons of oil a year are being consumed. The lamps are so arranged that three of them are reflecting their light to no useful purpose towards the interior.

I recommend that seven of these lamps be suppressed, and that the remaining four be compactly arranged, so as to show the entrance to the harbor. There can be no doubt of the utility of the light, as indeed, all lights known to the pilot are useful to him; but that the nature of the navigation, or the interest of commerce, justify or require a light of the present magnitude, is a question which does not admit of argument. The difference in the expense of the two lights will be $251 13' a year. The tower and dwelling here are of stone, and, as was remarked, have recently been erected. The keeper informs me that, in the late storm, both buildings leaked in all directions. The unskillfulness of the work extended to the lantern, the dome of which likewise leaked, rendering it prudent for the keeper to remain by the lamps during the rain, lest the light should become extinguished. I removed the surface of the mortar or cement, in several places, and found the stone to be laid in what appeared to be very little more than mere sand. The glazing of the lantern was to have been of Boston double-crown glass, but evidently glass of the thinnest kind has been used, the quality of which is nothing more than ordinary. I found the lantern to be only five feet eight inches
high, which is too low, again, for the convenience of the keeper with his hat on. The sash-bars, however, whether intentionally or not, were less objectionable, being only three-quarters of an inch wide, and yet abundantly stout. The shoalness of the navigation here renders necessary a multiplicity of buoys; accordingly, there are no less than eight belonging to this harbor.

Bird Island light.—This light is nearly at the very head of Buzzard’s bay, and, being near the centre of the bay, is seen by all vessels ascending it from the time they are abreast of Dumpling rock and Clark’s Point lights. It is a revolving light, precisely like the one at Gay head. The reflectors have been much injured by the lamps, and the frame of the clock-work and of the lantern are suffering for the want of paint.

I can see no reason why this should be a revolving light. Had I found Clark’s Point light so near to Dumpling Rock light, revolving, I should not have been surprised; but, except since Ned’s Point light has been erected, it was not possible for Bird Island light to be taken for any other, standing as it does, at the head of the navigation, aloof from all other lights. As, however, it has been thought advisable to have it readily distinguishable, I now recommend that it be converted from a revolving white to a fixed red light, to consist of 6 instead of 10 lamps; the lamps to be arranged in a circular form, to suit the surrounding navigation; and the reflectors to be laid aside, so as to permit the light of all the lamps to be seen from every point of the compass. This will make a difference in the expense of the light of $143.50 a year, which may as well as not be saved to the public, for, there being no other red light in the bay, it never can be mistaken, and, requiring not to be seen more than 6 or 8 miles, at farthest, it will always be sure to afford light to that navigation.

The keeper of this light informs me that the head of this bay is always frozen over for long periods during the winter, and that no instructions have ever been given to extinguish the light during such periods.

This light is 30 feet above the level of the sea, in a stone tower 25 feet high. The dwelling is also of stone, and requires some slight repairs in the fire-places and kitchen ceiling.

I have now to remark of the buoys in this bay, that there are 50 in addition to those already enumerated, most of which are in the shoal navigation above this light. I examined them, and found that, though numerous, they are needed, and to dispense with any of them would be to sacrifice the interests of commerce.

At the entrance to this bay there are some very dangerous rocks, called the Old Cock and Hen and Chickens. The Old Cock lies about two miles from Gooseberry neck, on the western side of the bay, and is in the immediate track of a large and increasing trade. I cannot doubt that Government will soon see the propriety of erecting a light-house on this rock.

Newport light.—This useful light stands on the southern extremity of Conanicut island, 98 feet above the level of the sea, in a stone tower 64 feet high. It consists of 15 lamps, with 9-inch reflectors, on two circular tables—8 on the lower, and 7 on the upper table. The reflectors are from 3 to 4½ inches apart, and 5 of them are so much worn as to be
of very little use. I recommend, as in other similar instances, the removal of these reflectors, so that the full power of all the lamps may be seen from all points of the compass.

I visited this light in the morning, and found the keeper had left home without having guarded against accidental detention, by first preparing his lamps, reflectors, &c., for use. Indeed, the reflectors had the appearance of not having been cleaned for some days, which might have been owing to the painting and repairs just done to the tower. Hence the importance of having these towers, as they might be, of materials rarely, if ever, requiring repairs, and never paint.

Premises in sufficient order.

**Goat Island light.**—This light is on the northern end of Goat island, in the harbor of Newport, and is useful to vessels in coming down the bay and entering the harbor. It is on a stone tower 20 feet high, and consists of 8 lamps, with 9-inch reflectors, circularly arranged. It will be observed that there are as many lamps here as in Monomoy light, a comparison with which cannot be drawn in the dangers of the navigation. I shall merely recommend the suppression of two of them, leaving the same number here as has been proposed for the other interior lights. Here, again, the lamps, being in a circle parallel to the horizon, the light of those on the opposite side of the circle is hid by the reflectors; therefore, I recommend their removal, the direct light of the six being stronger than the reflected light of three lamps.

This light is about to be removed to a new tower, on the end of the breakwater constructing from this island. It is to be hoped a larger lantern will be furnished that tower, this being only 5 feet high and 4 wide, a space altogether too small for the convenience of the keeper.

I found this light, late in the afternoon, in the filthiest condition of any light in the district. The reflectors had the appearance of not having been cleaned for a length of time; the glass in the lantern was darkened with smoke, and oil left upon the table and lamps showed the slovenly manner in which preparations for the night had been made.

The premises here are in sufficient order.

There are eight buoys belonging to this harbor, which are required by the navigation.

Having thus represented the state and condition of the light-houses, &c., in the district, it may be proper that I should recapitulate the alterations and improvements most important to the Government.

Recommencing with Boston light: That, in common with all the light-houses in the district, there be a new lantern here six feet high, exclusive of the dome, and six feet wide; the frame to be of copper, plated inside with silver; glass of the finest quality; frame to be strengthened on the land side, or on the least important side, so as to admit of narrow styles and sash-bars fronting the quarter where the light is most required by the navigation; no door to the lantern, but a separate scuttle in the top of the tower, through which the keeper can have access to the gallery. The railing around the gallery to be of copper, sufficiently stout on the land side, or on the least important side of the light, to steady and secure the lantern firmly in its place; while, on the sea side, where it is important the least possible number of rays should be intercepted from the
view, to be no larger than is necessary to the safety of the person employed in cleaning the outside of the lantern. Keeper, in common with others, to have a boat-house for the preservation of the boat.

Long Island Head light to be reduced from 11 to 6 lamps, and the reflectors to be removed.

Scituate light to be converted from a red and white light to a single red light; tower to be repaired, and a new dwelling of stone or brick to be erected for the keeper, contiguous to the tower.

Plymouth lights to be converted from two horizontal to two perpendicular lights. A new stone or brick tower, 60 feet high, to be erected; the lower light to be 15 feet from the base; a cellar to the tower, and a durable dwelling for the keeper, contiguous to the tower.

Barnstable light to be reduced from 10 to 6 lamps, and the reflectors to be compactly arranged.

Billingsgate light to be reduced from 8 to 6 lamps, to be compactly arranged, so that all their light may be seen seaward. A buoy for Channel rock in this harbor. The light on Mayo’s beach to be suppressed, or to become a tide-light, consisting of a single lamp.

Provincetown Harbor light to be reduced from 10 to 6 lamps, and they to be compactly arranged, to throw their light seaward.

Race Point light to remain as it is, unless a new lantern be placed there, when a more compact arrangement of the lamps would have to be made.

Cape Cod light to have the reflectors suppressed, and the lamp facing the iron door removed to the upper circle.

Nauset lights to be converted from three fixed white lights to one revolving red.

Chatham lights to be converted from two fixed white lights to one fixed red. A new brick or stone tower to be erected in place of the southernmost of the present towers, to be of the same height as that tower; to have a cellar under it, and, contiguous, a new dwelling for the keeper.

Monomoy light to have the reflectors suppressed, and, in the event of a new lantern being placed there, the lamps to be compactly arranged.

Point Gammon light to be reduced from 10 to 6 lamps, and the reflectors to be compactly arranged.

Edgartown Harbor light to be reduced from 10 to 4 lamps, and they to be compactly arranged, pointing the approach to the breakwater.

Cape Poge light to be reduced from 11 to 6 lamps, and the reflectors to be compactly arranged.

The light-boat on Cross rip to have a spare cable and anchor.

Nantucket Harbor light to be reduced from 8 to 6 lamps; the reflectors to be compactly arranged, and the keeper to have charge of the beacon building a little distance from the light.

Nantucket Great light to have the reflectors suppressed, and, in the event of a new lantern being placed there, the lamps compactly arranged.

Holmes’s Hole light to be reduced from 10 to 6 lamps, and the lamps to be compactly arranged in a single tier, to suit the navigation.

Nobsque light to be reduced from 10 to 6 lamps, and the reflectors to be compactly arranged.
Tarpaulin Cove light to be reduced from 10 to 6 lights; the reflectors to be compactly arranged; and, in the event of a new lantern being placed there, the tower to be raised about 15 feet. Slight repairs required to the tower and dwelling.

Gay Head light to remain as it is, unless a new lantern be placed there, when a more compact arrangement of the lamps would have to be made. Should my recommendations be adopted, there will be several reflectors spared from the other light-house, which are more perfect than some now in this light.

Cutterhunk light to have the reflectors more compactly arranged.

Dumpling Rock light to be reduced from 10 to 6 lamps, and they to be arranged to suit the navigation. One of the lamps now faces the shore.

Clark's Point light to be reduced from 10 to 6 lamps, and the reflectors to be compactly arranged.

Ned's Point light to be reduced from 11 to 4 lamps, and they to be compactly arranged, so as to light the entrance of the harbor.

Bird Island light to be converted from a revolving white, into a fixed red light of six lamps in a circle, without reflectors.

Newport light to have the reflectors suppressed; and in the event of a new lantern being placed there, the lamps to be compactly arranged.

Goat Island light to be reduced from 8 to 6 lamps, and the reflectors suppressed.

A law or regulation prohibiting light-keepers from engaging in any pursuit calculated to absent them from personal attendance on the light; also, requiring them to have the light ready for inspection by a fixed hour in the day.

There remains for me now to express my views on the "management, superintendence, and construction" of light-houses.

The present mode of "managing" is by contract. The oil, lamps, reflectors, &c., are supplied and repaired at a stipulated sum, annually, for each lamp. Of course, in proportion as the contract is profitable, will be the desire of the contractors to have the lamps multiplied. Hence, in locating light-houses, the commission appointed for that purpose should also apportion the number of lamps to each of them. I think it will be apparent that most of the light-houses have more lamps in them than are necessary. One thing is certain, there are eight lamps now burning in the district to no useful purpose. If the other districts have an equal number, here will, at once, be the sum of $2,295 70 expended annually, without any other advantage than what may accrue to the person enjoying the contract. Again: as I understand, the agreement is, that the contractor should maintain the lamps in the condition in which he found them; so that, whether perfect or not, they remain stationary to the end of time. A better plan would be, to have the lamps, reflectors, and glass, in Government hands, subject to the requisition of the light-keepers, approved by the district superintendents. Then, if any alterations or improvements be made, they pass into immediate effect. Other articles might be supplied in the usual way, subject to the inspection of the district superintendents. Heretofore, all works in this department have been executed by contract. Some account has been given of those recently done, and the constant
repairs necessary to others show that either skill or fidelity was equally wanting in them. Therefore, it would be better to have architects or engineers belonging to this department, whose reputation would insure the public against fraud or ignorance. There would then be, according to my ideas, a superintendent general, with district assistants, a corps of engineers or architects, and an artist to superintend the manufacture and have charge of the lamps, reflectors, and glass. And, in order that a vigilant care might be had of the light-houses, light-boats, beacons, and buoys, it would be necessary that each district superintendent should have a vessel of between 30 and 40 tons at his disposal.

I have the honor to be, very respectfully, your obedient servant,

E. W. CARPENTER,
Lieut., U. S. Navy.

Hon. Levi Woodbury,
Secretary of the Treasury, Washington.

---

New York, November 1, 1838.

SIR: Agreeably to the fourth section of the law of Congress, passed July last, on light-houses, light-boats, beacons, buoys, &c., I have examined "between Suconesset point and a shoal called the Horseshoe, in the northern channel of Vineyard sound," for the purpose of ascertaining whether it be a suitable place for a light-boat, and whether the interests of commerce and navigation require that one should be placed there.

The object of this boat is to enable vessels to make this passage at night, which they cannot now do in consequence of the numerous shoals which fill this navigation. By having a light moored between Suconesset shoal and the Horseshoe, so as to be seen from Nobsque and Point Gammon lights, vessels bound through, either from the northward or the southward, would be enabled to continue on their way without detention. The course from Nobsque to the boat would be due east 10 miles, and from Point Gammon W. SW. the same distance.

It is supposed that about one-third the passages are made through this channel that are made through the southern, where there is a light-boat, which recorded ten thousand five hundred and eighteen vessels to have passed in sight of her during the last year. All these vessels are subject to detention at night, for the want of the proposed facility. Vessels have occasionally attempted to run through, but it has always been at a great risk, and many have paid for their rashness by the loss of themselves and their cargoes. In winter, when the westerly winds have set the ice over from the shore, it is of great importance this channel should be lighted, for then it will be much frequented; and the loss of a night, when considered in the aggregate, will fully justify the expense of maintaining a boat. Besides, it is not only at night that such conveniences are of use. By day, as a buoy, and in foggy weather, through an alarm bell, she is of great value to the navigation. I can, therefore, have no hesitation in recommending the proposed measure to the sanction of the Government.
The accompanying letters, marked A, B, C, and D, show the opinion of those retired shipmasters whom it was in my power to consult on this subject.

I recommend, that as this light will range from Point Gammon with the light at Holmes's Hole harbor, to prevent mistakes, it be in a red lantern.

I have the honor to be, very respectfully, your obedient servant,

E. W. CARPENDER,
Lieutenant, U. S. Navy.

Hon. LEVI WOODBURY,
Secretary of the Treasury, Washington.

NEW YORK, November 1, 1838.

SIR: Agreeably to the fourth section of the law of Congress, passed July last, on light-houses, light-boats, beacons, buoys, &c., I have examined a point called the "Point of Rocks," in the harbor of Westport, for the purpose of ascertaining whether it be a suitable place for a light-house or beacon, and whether the interests of commerce and navigation require that one should be placed there.

Westport is a small harbor, nearly half-way between New Bedford and Newport; it has a navigation consisting of eight whalermen and several coasters.

The difficulty with this harbor is in the dangers of the approach to it, there being several rocks and ledges lying off the mouth of it, which deter vessels from entering; besides, the entrance is so narrow, and the coast so uniform, that, even in the day time, it is not an easy matter to detect the harbor. When once within the harbor, there can be no safer anchorage, the rocks so effectually exclude the sea and afford shelter from the wind. By having a light-house on the "Point of Rocks," vessels anywhere in the offing that have brought the light to bear N. NW. by compass, may steer clear of all danger, and enter the harbor in safety. As soon as I had ascertained this fact, I could no longer hesitate on the propriety of recommending the proposed measure to the sanction of the Government. This light will not only be serviceable to the trade of Westport, but coasters, opposed by head winds, or threatened with stormy weather, may avail themselves of it to make a harbor without putting back to a distance. Westport, though a small, is an enterprising place, and their success of late years in the whale fishery is enabling them to make additions to the number of their vessels. Vessels of ten-feet draught can enter the harbor at low tide, which is sufficiently large to accommodate any number likely to resort there.

The light-house should stand on the extreme point of the rocks, at an elevation of twenty-five feet above the level of the sea, which will enable the light to be seen fully as far as will ever be required. Six lamps will be enough for the light, and they should be compactly arranged so as to throw their light directly along the only track where it can be of any use. I may add that the site is one which ought to be visited by an
engineer, as the tower will be somewhat exposed to the sea, and there will be required a short footway of masonry from the tower to the only spot suitable for the keeper's dwelling.

I also recommend that the following buoys be laid down outside the harbor, namely: one on Lumber rock, at the southwest point of Gooseberry neck; one on the eastern edge of the Two-mile ledge; and one on Dogfish ledge; and, inside the harbor, a buoy on the edge of the middle ground.

Accompanying this report are letters, marked A, B, C, D, from retired shipmasters at Westport, whom I consulted, favorable to the proposed light-house.

I have the honor to be, very respectfully, your obedient servant,

E. W. CARPENDER,
Lieutenant, U. S. Navy.

Hon. Levi Woodbury,
Secretary of the Treasury, Washington.

REPORT OF LIEUTENANT GEORGE M. BACHE.

WASHINGTON CITY, November 22, 1838.

SIR: In compliance with the requisitions of the act of Congress entitled “An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year one thousand eight hundred and thirty-eight,” approved July 7, 1838, I have the honor to submit a report of the surveys, examinations, and inspections, made within the third district on the Atlantic coast, and the results of the inquiries ordered under the third section of the aforesaid act.

The third district, extending from Newport to New York, embraces within its limits the Narragansett bay, Long Island sound, and the bays and harbors in confluence with these waters, together with the Hudson and East rivers.

In order to ascertain “the present condition and usefulness” of the objects referred to in the act, I visited and inspected each one as it presented itself, on the tour which I made through the district, and noted such facts as appeared to have a bearing upon the inquiry with which I was charged.

Commencing at the eastern boundary of the district, my attention was directed to the light-houses, beacons, buoys, &c., established for the improvement of the navigation of Narragansett bay, and the benefit of vessels frequenting the harbors on its margin. The lights are seven in number; of which five are general, and two are harbor lights.

No. 1. Point Judith light, (revolving,) on the southeast point of the Narragansett shore, in lat. 41° 22', long. 71° 30', is useful to vessels passing or entering the Narragansett bay; it is elevated 74 feet above the level of the sea, and in clear weather, under ordinary refraction,
should be seen at a distance of 14½ miles from a height of 15 feet; * owing to the haziness of the atmosphere when it was passed on this inspection, it was not visible at that distance.

This light was established in the year 1810; the tower is 35 feet high; it is built of rough stone, faced with free-stone laid in courses, and coated with cement; the cement has fallen off in many places.

The lighting apparatus consists of ten lamps, with the same number of parabolic reflectors and plano-convex lenses, supported upon two copper tables, which have the machinery for producing their revolutions attached. The lamps are divided into two clusters, and are so arranged upon the tables that each cluster of five lamps will display its light for a certain period during each revolution; the rims of the tables are segments of circles, and the reflectors are placed round them so as to produce a vertical divergence on their axes; this arrangement diminishes the brilliancy of a revolving light, while it increases the duration of the period of light.

The lamps are in bad order, and not firmly fixed upon the tables; some of them have screws, and others small wedges of wood under their tube-barrels, which, the light-keeper informed me, had been placed there to elevate that part of the lamp, in order to prevent the overflowing of the oil. The reflectors are attached to the lamps by thin hooks of sheet iron or tin, and are movable in every direction; their axes make different angles with the horizontal line. Each reflector is 8½ inches in diameter, and weighs from 9 to 12 ounces; the silver is so much worn from the concave surface of three of them that the copper is exposed in spots.

A plano-convex lens is placed in front of each light and reflector, with its plane surface towards them, and varying in distance from the light from 5½ to 6¼ inches. These lenses are of green glass, set in copper rims; they are 9 inches in diameter, and 2½ in depth; their average weight is 8 pounds 10 ounces.

The motive power of the machinery is a weight of 228 pounds, attached to a rope which is wound over a horizontal barrel; this barrel is connected with a spindle by means of a wheel and pinion, and upon the spindle the tables are placed; motion is in this manner communicated to the tables, and it is regulated by the revolution of a series of vanes, which are connected with the spindle by means of horizontal wheels and pinions. The light-keeper is only aware of this machinery having stopped once. viz.: on the night of the 20th November, 1837. It has, however, a continual tendency to go at a slower rate than that required; to counteract which an addition is, from time to time, made to the motive power. On putting it in motion, the tables performed half revolutions every 1 minute 12 seconds, which was 3 seconds slower than its proper rate. The keeper was under the impression that the light should be shown every 1 minute 30 seconds, but he had no watch or other means of measuring time accurately.

The tower is damp, and in cold weather the moisture frequently con-

* In calculating the distances at which the lights in this district should be seen, the height of the eye of the observer is supposed to be 15 feet above the level of the sea, which is generally the case when the observation is taken from the deck of a coasting schooner. The miles are nautical miles of 6,430 feet each.
denses and freezes upon the glass of the lantern. The light-keeper in-
formed me that, occasionally, the ice formed in this manner has been of such
thickness that he has been obliged to permit it to remain on the lantern
for some days, until the wind should come from the southward and enable
him to take it off without danger of breaking the glass.

The dwelling-house, containing seven rooms, is of frame; it requires
painting and a new kitchen floor. There is also belonging to this estab-
ishment a stone oil-vault, detached from the other buildings; it is so
much out of repair that the oil is stored in the tower.

No. 2. Newport or Beavertail light, (stationary,) situated on the
southern extremity of Connanicut island, in latitude 41° 26' north, longi-
tude 71° 26' west, serves to point out the entrances to Narragansett bay
to the eastward and westward of its position. It is elevated 98 feet above
the level of the sea, and its limit of visibility is 15$\frac{1}{2}$ miles.

The tower, from which the light is shown, is sixty-four feet in height;
the masonry is of rubble-stone, of small size, roughcast on the exterior;
it is ascended by an interior spiral stairway of wood, having landings at
convenient distances. The oil is stored under the lower landing.

The lanterns contain fifteen lamps, with reflectors, arranged around
two circular copper tables, each three feet in diameter. The lower table
supports eight lamps, which illuminate every point of the horizon; on the
upper table there are seven lamps, the vacant space being towards the
land. These are so arranged that the axes of the reflectors, in the upper
circle of lights, are over the spaces between the reflectors in the circle
below, an arrangement well calculated to diffuse the light pretty equally
in every direction, when the reflectors are in good order and properly
adjusted; in this instance, however, several of the reflectors are bent
from their original forms, which is probably owing to their great light-
ness, their diameters being 9 inches, and weight from 7 ounces to 1 pound;
two of them are very much worn and cracked. The light-keeper informed
me that they had been furnished by the contractors on their last annual
visit.

The dwelling-house, which was built at the same time with the tower,
being too near the water and on bad foundation, was destroyed in Sep-
tember, 1815. The present dwelling was erected in 1816; the walls are
of rough stone of small size, and are badly laid. A portion of the
masonry, being supported solely by the frame-work of the cellar win-
dows, is cracked. Such, I was informed by the light-keeper, was the
case with the masonry over the windows and doors of the first floor, until
proper lintels of stone were inserted. The house originally contained
five rooms; a brick addition of two rooms was made in 1834. A stable
and wood-house are also on the premises.

In 1829 a bell-house was built near the base of the tower, and a bell
placed in it; these were removed in 1833. A portion only of the wall
of the house is now standing.

No. 3. Dutch Island light, (stationary,) on the south end of Dutch
island, in the passage to the westward of Connanicut island, bearing from
the Beavertail N. 1° 30' E., distant 2$\frac{1}{2}$ nautical miles, is a good guide
to vessels going through the west passage either into or out of Narra-
gansett bay. This light is shown from a tower which is connected with
the keeper's dwelling, and is fifty-six feet above the level of the sea; its limit of visibility is thirteen miles.

The lighting apparatus consists of eight lamps, with parabolic reflectors attached to their fountains, standing around a copper table, so as to leave a vacant space of $35^\circ$ in the direction of the island.

The reflectors average in weight 10 ounces; their diameters are 8.5 inches, and depth 1.9 inch; and they are placed so that each one will have a light about three inches from its vertex.

The lamps are not firmly secured in their places, being merely supported behind by two legs of thick wire, which fit loosely into sockets on the table, and in front they rest upon screws which are attached to their tube-barrels. These screws appear to have been added since the lamps were furnished; they are used, as in light No. 1, to elevate or depress the part of the lamp to which they are attached, according as a greater or less supply of oil is required by the wicks; but, as the reflectors are attached to the lamps, and are movable with them, their axes are elevated or depressed as the lamps are regulated by these screws. The axes of the reflectors were found making different angles with the horizontal line, being generally elevated above it; owing to which, the best portion of the reflected light would be entirely lost.

The original arrangement of this apparatus has been faulty; for, taking the dimensions of the reflectors to determine their curves, it is found that the focus of each is 2.37 inches from its vertex; the flames of the lamps being .63 of an inch without these foci, a convergence and consequent divergence of $16^\circ$ will be produced in the light reflected; but, as illumination is required over $325^\circ$, each reflector should throw its light over a sector of $40^\circ$. From the whole arrangement of this apparatus, it is evident that the illumination is derived almost entirely from the direct rays of the lights, and that the reflectors are rendered nearly useless.

The dwelling-house and tower were erected in 1826; they are built of the slate and other stone found on the island. The house contains four rooms, which are not neatly kept. The oil is stored in the cellar of the building.

No. 4. Warwick Neck light (stationary) is situated on the southern extremity of Warwick neck, bearing from the Dutch Island light N. 10° E., distant ten miles.

Vessels making the passage to the westward of Prudence island, in Narragansett bay, to the northward and eastward, or in Greenwich bay to the southward and westward, are benefited by this light, as it serves to point out the narrow passage between the point on which it is situated and the northwestern extremity of Patience island, which lies two-thirds of a mile from it.

The light is shown from a tower on the keeper's dwelling, and is afforded by eight lamps, which are arranged around the three-fourths of the circumference of a circular table, included between the northeast and northwest points. The lamps are in bad order; the light-keeper complains of the oil overflowing their wicks. The reflectors are nine inches in diameter; the silver is much worn from their concave surfaces, which tends to diminish the quantity of light reflected.
The buildings consist of a stone house and tower, with a frame building attached—the former built in 1826, and roughcast in 1835; the latter added for the accommodation of the keeper in 1833. The dwelling leaks badly at the junction between the stone and frame portions of it; the deck or roof of the tower was covered with a coating of cement in the autumn of 1837, which has since sealed off, leaving the tower in a leaky condition. Mechanics had just arrived from Newport in order to make the necessary repairs.

The oil is kept in one of the rooms of the building. There is included in the quantity returned as winter oil, thirty-six gallons of old oil, which is thick, and supposed of bad quality; it has been on hand seven years.

No. 5. Nayat Point light, (stationary,) on the southwestern extremity of Nayat point, bears from Warwick Neck light N. 35° E., distant 3½ miles. Vessels arriving at or departing from Providence river are benefited by this light, as it serves to point out the narrow passage between the point from which it is shown, and the shoal off Conanicut point. It is elevated thirty-eight feet above high-water mark; its limit of visibility is 11½ miles. The tower is 23 feet high; it was built of brick, in 1828, and has a winding stairway of wood in the interior. A stone wall protects it from the encroachment of the water to the southward, and the southward and westward.

The lighting apparatus consists of six lamps with concave reflectors, so arranged upon a circular table as to illuminate three-fourths of the horizontal circle, which, on account of the trenching of the land, is 20° more than is required to be illuminated. The lamps are in the same condition as those at light No. 4. The reflectors are of two sizes; the larger size are nine inches in diameter, and weigh nine ounces each; the smaller size are eight and a half inches in diameter, and weigh seven ounces. There are many indentations upon them, and the silver is much worn from their concave surfaces; two of the smaller size are bent from their original forms. The dwelling-house, containing five rooms, is of stone, and requires frequent repairs.

No. 6. Poplar Point light (stationary) is situated on the extremity of Poplar point, at the entrance to the harbor of Wickford, bearing from the Scotch Island light N. 11° W., distant 4½ miles.

This light is shown from a wooden tower placed over the keeper's dwelling, and is elevated forty-eight feet above high-water mark.

The lighting apparatus consists of eight lamps with concave reflectors, so disposed around two circular rims or hoops as to throw their light over the portion of the bay and harbor included between the SE., by E. and NW. by W. points.

The lamps are in good order. The reflectors average in weight nearly three pounds; their diameters are 1¼ inches. A portion of the silver has been rubbed from their concave surface at the upper hole, through which the glass tube should pass; they are otherwise in good condition.

The dwelling-house, of stone, built in 1831, is in good repair, and the establishment appears to be well kept.

This light is not required for the improvement of the general navigation of the bay, and, owing to its situation, is of little service to it. Its utility, therefore, may be very nearly measured by the service it renders
the trade of North Kingston or Wickford. According to the latest enrolment, the number of vessels belonging to the port of North Kingston, and engaged in the coasting trade, were 15, carrying $611\frac{2}{5}$ tons; engaged in the cod fishery there were five vessels, carrying $383\frac{3}{5}$ tons. Six of these vessels are schooners, and fourteen are small sloops or boats.

I have no means of determining the average number of nightly arrivals at and departures from this port, throughout the year; but even supposing the vessels enrolled to be employed in a direct trade to it, their number would not be great. None but those very well acquainted with the navigation would venture into Wickford at night, in preference to remaining at the excellent anchorage in its neighborhood, between Conanicut and Dutch islands.

No. 7. Goat Island light, (stationary,) on the northern extremity of Goat island, was established to light vessels into the inner harbor of Newport; it bears from the Beavertail light N. 59° 15' E., and is distant from it four miles. The tower from which it is shown is 20 feet in height, with a base 14 feet in diameter; it is built of brick, faced with slabs of freestone, which join at the angles; it is at present in a very bad condition, owing to its faulty construction. The lighting apparatus consists of eight lamps, with reflectors arranged around a circular table so as to show light in every direction. The reflectors are parabolic, 9 inches in diameter; each one is attached to its lamp by a single hook, and is movable in every direction. In consequence of deficient ventilation and the dampness of the tower, the lantern is subject to the condensation of moisture upon the inner surface of the glass, and ice is occasionally formed. I observed this condensation at the period of my visit, although the weather was moderately warm. The cleanliness of the lantern and apparatus did not appear to have been attended to by the light-keeper.

The dwelling-house contains six rooms; its walls are of rough stone of small size, and are badly built. The lintels of the doors and windows are, with one exception, too short to be supported by the masonry below them, but rest upon the door and window frames over which they are placed. These lintels appear to have settled, and the masonry above them has cracked. The oil is kept in the cellar of the dwelling.

Owing to a reef and shoal extending out for some distance from the point on which this light is situated, vessels have occasionally grounded at night, on rounding it. A dike, covering the reef, is now in the course of construction, under the direction of the Engineer department; and a substantial granite tower has been placed on the pier at its extremity. So soon as the whole work is completed, the light will be shown from this tower, and that upon Goat island will be discontinued.

Block island is situated near the track of vessels passing between Narragansett bay and Long Island sound; it is about five miles in length from north to south, and is nearly two miles wide; to the southward it terminates in a bluff nearly 250 feet high, while its northernmost point is low, and has a reef extending out from it. The light is situated upon the northern point in latitude 41° 14' N., longitude 71° 37' W., and bears from the Newport or Beavertail light S. 38° 30' W., distant 15 miles.
No. 8. Block Island light (stationary and double) is useful to vessels plying between the Vineyard and Long Island sounds, and those bound into or out of Narragansett bay; its elevation is 45 feet, and limit of visibility 12 miles.

The light was established in the year 1829, when it was shown from a building at the extremity of the point; owing to the encroachment of the sea to the eastward, a wall was built for its protection in 1836. The present building was erected in 1837, on a site sufficiently removed from the sea to render it secure. This building is 50 feet in length; the walls are of granite, well laid in cement; and justice appears to have been done it throughout by the contractor. The lights are shown from towers over either end of the building, bearing from each other north and south. The lighting apparatus in each lantern consists of seven lamps with parabolic reflectors, disposed so as to show their strongest light from E. by S. north-about to S. SW. The reflectors are 15 inches in diameter, and average in weight 3½ pounds. The lights are placed without the foci of the reflectors, so as to produce a divergence in the light reflected of 30° and 40°; but it does not appear brightly when seen at a distance, which is probably owing to the number of lamps in each lantern being too small for the portion of the circle illuminated, as each lamp is required to throw light over a sector of 43°.

Annexed is an abstract from a list of vessels wrecked on Block island, from the year 1819 to 1838, inclusive, which shows that in a period of twenty years 59 vessels have been stranded there. Although the number of wrecks increased in the first year after the establishment of the light, it appears that many of them occurred under peculiar circumstances. Such circumstances, together with the great increase of trade, should be taken into consideration in determining the utility of a light from such data; and as the immediate cause of each wreck has not been specified in the list, it cannot properly be made use of for that purpose; but the abstract from it is given to show the danger attending the navigation near this island, and the propriety of maintaining a light of great brightness upon its most dangerous point.
Abstract of the number of vessels stranded upon Block Island, from the year 1819 to 1888, inclusive.

<table>
<thead>
<tr>
<th>Year</th>
<th>Description of vessels</th>
<th>Proportion.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ships</td>
<td>Brigs</td>
<td>Schrs</td>
</tr>
<tr>
<td>1819</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1820</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1821</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1822</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1823</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1824</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1825</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>1826</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1827</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1828</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1829</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>1830</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1831</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>1832</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>1833</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1834</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1835</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1836</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1837</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1838</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Three schooners could not see the land on account of a heavy fall of snow. One sloop was knocked down and disabled off Watch hill, and was purposely run ashore.

The schooner Warrior had been at anchor off the NW. point; the wind changed to NW., and she was unable to get off. All hands, thirteen in number, perished.

Both in a heavy fog.

Ship Sagamore, 164 days from Cronstadt, ran on SW. part of the island, in the day-time, by manœuvring badly. Ship Ruth and Mary, whaler from New London, in a fog. One schooner riding out a NE. gale.

Two schooners ran on in fog.

On the north point of the island.

In Long Island sound, and its neighborhood, there are 20 lights, two of which are shown from light-boats anchored near dangerous shoals; the others are situated either on points, islands, or at the entrances to harbors; and nearly all are useful to the general navigation of the sound.

No. 9. Montauk light, ((stationary,) on Montauk point, at the east end of Long island, in latitude 41° 4' N., longitude 72° W., is passed by all vessels approaching Long Island sound from seaward, and is a good point of departure for those about leaving the sound. It is also frequently made by vessels from the southward bound to the northward and eastward, and by those approaching New York bay from the eastward. Its elevation is 160 feet, and its limit of visibility, from a height of 15 feet, is 19 miles. The light-keeper of the vessel off Bartlett's reef informed me that from his station, which is distant from Montauk point 173 miles, this light can only occasionally be seen; this is attributable to the haziness of the atmosphere near the horizon—a condition which is usual on this part of the coast during the spring and summer months.
The tower from which the light is shown, was built in the year 1795, and is 80 feet in height; the masonry is of Chatham freestone, fine, hammered, and laid in courses on the exterior. It is ascended by an interior spiral stairway of wood, having landings at convenient distances.

A new lighting apparatus was placed in the lantern in July, 1888; it consists of 18 lamps with parabolic reflectors, which are arranged around two iron tables—ten upon the upper, and eight upon the lower table; the vacant space below being towards the land. The reflectors are 14½ inches in diameter, and weigh from 3 lbs. to 3 lbs. 6 oz.; the tube-glasses in use are too short to project through the holes in the reflectors.

There are three dwelling-houses belonging to this establishment; the oldest house is of frame, containing three rooms, and is very much out of repair; another frame building is connected with it, and contains four rooms; a brick building containing six rooms has recently been added.

No. 10. Watch Hill light, (revolving,) on Watch Hill point, in latitude 41° 18' 45" N., longitude 71° 58' 56" W., is situated at the eastern entrance to Long Island and Fisher's Island sounds, and bears from Montauk light N. 6° E., distant 13½ miles. It is useful to vessels approaching this part of the coast at night, or going through the narrow channel which leads into Fisher's Island sound from the eastward. Its elevation is 73 feet, and limit of visibility nearly 14½ miles. The tower, 35 feet high, is entirely of frame, weatherboarded, and painted; it was erected in 1808, and is now apparently in good condition. The lantern contains ten lamps with parabolic reflectors, disposed around two frames or rings of iron, in two clusters; these frames are segments of circles of 45½ feet radius, and the reflectors are so placed that the axes of those at the extremities of each cluster diverge from each other 35°, being an arrangement similar to that at light No. 1. The reflectors are 13½ inches in diameter, and average in weight 2 lbs. 5 oz.

The machinery for producing the revolution of the tables is similar to that at light No. 1. On setting it in motion, the mean of several revolutions gave 2' 42" as the rate of a complete revolution: accordingly, the middle of the periods of brightness would be observed every 81". Subsequently, on passing this light at night, the middle of the period of brightness occurred every 66"; the duration of the light varied according to the distance from which it was observed, increasing as it was approached, until a feeble light could be constantly seen between the periods of greatest brightness. I saw this light on another occasion, at a distance of 17 miles, from a height of 40 feet; the weather was clear.

The lighting apparatus, with the exception of the machinery for causing the revolutions, was furnished in July last. The following notes respecting the machinery are extracted from the journal of the light-keeper:

"1835, July 23, clock stopped. "1836, Oct. 6, clock stopped.
Oct. 5, do.
"A man came to repair the clock in the light-house at Watch hill, on the 14th day of December, 1836, and it was obliged to be carried away to be repaired, and was not brought back till some time in the night; and it had to be a standing light in the fore part of the night. December 21, clock stopped."

The heavy lenses, formerly used here, were taken from the tables between the 1st of January and March, 1837; their removal afforded considerable relief to the machinery; but subsequent to it the following notes were made in the diary:

"1837, Mar. 15, clock stopped. 1838, Jan. 25, clock stopped.
Nov. 9, do. July 1, do."

"1838, Jan. 11, do.

As this light is rendered stationary by the stopping of the machinery, it is liable, at such times, to be mistaken for the stationary light at Stonington, in its neighborhood, and serious accidents might occur in consequence of it.

There is a frame house for the accommodation of the keeper of the establishment; it contains five rooms, and is in good order.

The oil is stored in a stone oil cellar, which is detached from the other buildings.

No. 11. Stonington light, (stationary,) situated on the extremity of the narrow point of land to the southward and eastward of the harbor of Stonington, is a guide for vessels while passing the Fisher's Island sound from the southward and westward, or making the harbor of Stonington from the southward or westward. It is shown from a height of 47 feet, its limit of visibility being 12½ miles.

The buildings of this establishment are, a stone tower 30 feet in height, and a stone dwelling-house for the light-keeper; they were built in 1823, and are now in good order, the wooden stairway of the tower having been lately renewed.

The lantern contains ten lamps with parabolic reflectors disposed around two horizontal iron tables, so as to show light from NE. southward to NW. by N. The reflectors are 13 inches in diameter, and average in weight two pounds two ounces each. The whole apparatus is in good order, with the exception of the silver being much worn from the upper portion of the concave surfaces of the reflectors.

The point of land on which the buildings stand is much exposed to the action of the waters during heavy south and southwesterly gales. High-water mark now lies within 45 feet of the tower, and the earth has been washed away to within 30 feet of its base. According to the account of the light-keeper, 22 feet of the bank has been carried away from the extremity of the point since the year 1823, and the same action has been going on, though in a less degree, to the eastward and westward of the dwelling. It will be advisable to protect these buildings from the further encroachment of the sea, by constructing a wall, which may commence at a rock on the northeastern boundary of the public land, bearing from the NE. corner of the light-house N. NE., and distant 120 feet, and extend 95 feet in the direction S. 6° E., to another rock, which bears E. by N. half N. from the same corner of the light-house,
distant 50 feet. From this point the wall may be carried round 120 feet, not approaching the light-house nearer than 40 feet, when it will strike near a stone bearing SW. by S. half S., 40 feet distant from the SW. corner of the light-house; thence carried NW. one-quarter N., 170 feet, it will strike the NW. boundary of the public land. The boulders upon the beach in the neighborhood of the light-house should not be used in the construction of this wall.

No. 12. Morgan's Point light, (stationary,) at the entrance to the river Mystic, bears nearly west from Stonington light, distant four miles. It was established for the benefit of the trade in its immediate neighborhood, in the year 1831. The tower from which it is shown is 25 feet in height, and is built of stone, having a stairway of wood in the interior. The lantern contains ten lamps, with reflectors, which illuminate nearly three-fourths of a circle from the W. NW. to the NE. by N. point. The lamps are out of order; each reflector is attached to its lamp by a single hook, and is movable in every direction. A piece of wood is inserted between each lamp and its reflector, below the hook, by which the axes of the reflectors are elevated above the horizontal line; by this arrangement the brightest portion of the reflected light is thrown away.

The reflectors are thirteen inches in diameter, and weigh from two pounds twelve ounces to three pounds; the silver is rubbed from their concave surfaces in many places. Three good opportunities were afforded me for observing the effect of this light; once, while at anchor near the South Dumpling, distant from Morgan's point two and a half miles, the weather hazy, the light was scarcely discernible. Stonington and New London lights, although at a greater distance, appeared with greater brightness than the light in question. At a distance of seven miles, it was not visible on the nights of the 5th of September and 5th of October, the weather being clear.

The dwelling-house is of stone; it contains six rooms, and is in a good state of repair. The establishment is kept with great neatness by the widow of the former keeper.

No. 18. Little Gull light, (stationary,) latitude 41° 12' 18" N., longitude 72° 9' 5" W., is situated upon the Little Gull island, to the westward of the passage called "The Race;" the west end of Fisher's island, or Race point, bearing N. 66° E., distant nearly four miles; Montauk Point light bearing S. 48° E., distant 13½ miles. It is a light of great importance to vessels approaching or passing through "The Race," or going into Gardner's bay. Its elevation is 66 feet, and limit of visibility 13½ miles. It was established in the year 1805; the tower is 53 feet high, and built of smooth hammered freestone, laid in courses, and ascended by an interior spiral stairway of wood.

A new lighting apparatus was placed in the lantern in January, 1888; it consists of fifteen lamps, with parabolic reflectors, which are arranged around two circular tables—eight upon the upper, and seven upon the lower table; the vacant space below being towards Plumb island. The reflectors are 13½ inches in diameter, and average in weight two pounds six ounces; they are supported firmly by brackets, which project from the tables. The tube-glasses in use are only six inches long, and are so placed that the smoke from the lamps collects upon the upper part of
the reflectors. At the time of my visit the light-keeper had been absent four days, owing to sickness; and the lighting apparatus had been apparently neglected by the assistant keeper in charge of it.

The dwelling-house is of frame; it contains seven rooms, and is in a good state of repair. The buildings are enclosed, and protected from the sea by a strong circular wall 800 feet in circumference, and 11 feet in height from its foundation. This is rendered necessary by the smallness of size and little elevation of the island. The well belonging to the establishment often fails, and a cistern is much wanted. The keeper is furnished with a good boat, &c.

No. 14. New London light (stationary) bears from the Gull light N. 10° E., distant 6½ miles. It is situated on a rocky point to the westward of the entrance to the river Thames, and is two miles from the town of New London; it is of great importance as a leading light for vessels going in or out of the harbor of New London, which, on account of its position and security, is much resorted to during the heavy gales of winter.

The light is shown from an elevation of 111 feet, which, in clear weather, should render it visible 16½ miles; it was established in the year 1800. The tower is a substantial building of freestone, smooth hammered, and laid in courses; it is 80 feet in height, and is ascended by an interior stairway of wood, having landings at convenient distances. This stairway is now in good order, and has not been renewed since the erection of the building.

The lighting apparatus consists of 11 lamps, with parabolic reflectors, disposed around two horizontal tables so as to throw the light from W. SW. south-about to N. by E. The reflectors are 13 inches in diameter, and average in weight 2½ lbs. 9 oz. Each one is firmly supported in its place by an iron bracket which is attached to the table. This apparatus was furnished in 1834, and is now in very good order. The tube-glasses in use are 8½ inches long. The light-keeper covers the ordinary wicks with small pieces of cotton cloth, which he thinks increases the consumption of oil, and causes the lamps to give a brighter light.

The brick building, formerly occupied by the keeper, has fallen into ruin; two of the rooms in its basement are used as store-rooms for oil.

The dwelling-house contains five rooms; it is of frame, and is in good order. The well belonging to it requires deepening, and the fences around the public land are out of repair.

No. 15. The light-boat off Bartlett's reef.—This vessel is moored to the southward and westward of Bartlett's reef, New London light bearing N.E., distant 3½ miles; and Little Gull light S. ¾ E., distant 4½ miles. It shows two lights at an elevation of 28 feet above the sea. Its present condition and usefulness will be shown while considering the expediency of placing a "light-boat of increased size on Bartlett's reef."

No. 16. Plumb Island light, (revolving,) on the westernmost extremity of Plumb island, in latitude 41° 10' 30" N., longitude 72° 15' 22" W., is a leading light to vessels passing up or down the sound, and is useful to those coming into Gardiner's bay, either from the eastward or through the narrow passage between Plumb island and Oysterman's point on Long Island.
The tower, erected in 1826, is 30 feet high, and built of rough stone. The lantern contains 10 lamps, with parabolic reflectors, arranged in two clusters, as in lights Nos. 1 and 10. The axes of the reflectors, at the extremities of each cluster, diverge from each other at an angle of 40°. The machinery for producing the revolution of the lights is also similar to that at light No. 1; on being set in motion, it caused half revolutions every 66''.

The reflectors are 13 inches in diameter, and average in weight 2 lbs. 3 oz.; they are a little worn at the upper part of their concave surfaces. The tube-glasses in use are 5½ inches long. The dwelling contains eight rooms, and the establishment appears to be kept in good order.

No. 17. Lynde Point light (stationary) is situated on the extremity of Lynde or Line's point, at the mouth of the Connecticut river, bearing from the Plumb Island light NW. 1½ N., distant 8¾ miles. It is a guide to vessels going in or out of the Connecticut river, or passing through the sound at night; but, as there is an extensive shoal at the mouth of the river, and another lying from 2 to 5½ miles to the southward and westward of the light, it must be approached cautiously from any direction. Its elevation is 44 feet, and limit of visibility 12 miles; it is only occasionally seen, however, from the light-boat off Bartlett's reef, which is but 9½ miles from it.

This light was established in 1803; the tower is 35 feet high, and built entirely of frame. The lighting apparatus consists of seven lamps, with reflectors, and six plano-convex lenses, arranged around a circular table so as to throw light from W. SW. south-about to W. NW. The lamps are not firmly secured in their places; they have fixtures similar to those at light No. 3.

The reflectors are 8½ inches in diameter, and average in weight 9 oz.; owing to their thinness, they have not preserved their original forms. They were furnished, the light-keeper informed me, by the contractors in 1835. These reflectors have not been properly fitted to the lamps, and they cannot be placed with their axes in the proper direction. The lenses are similar to those in use at light No. 1; two of them are broken, but are still retained in use.

The dwelling-house, containing six rooms, is of frame, and is in good order. A stone oil cellar stands near it, but, being below the high-water mark of spring tides, it is sometimes flooded, and is, therefore, not used.

The tower is very much decayed, and is about to be taken down; a contract having been made to erect a stone tower in its place.

No. 18. Falkner's Island light, (stationary,) on the southern part of the small island of that name, bears from Lynde Point light W. by S., distant 14½ miles; and, from the southwestern extremity of Sachem's head, it bears S 46° E., distant 3½ miles.

This light is serviceable to vessels passing through the sound, or seeking the anchorage to the northward of Falkner's island; its elevation is 98 feet, and its limit of visibility 15½ miles. It was established in 1801. The tower, 40 feet in height, is of freestone, laid in courses, and ascended by an interior stairway of wood. The lantern is furnished with
twelve lamps with reflectors, and eight lenses, which are placed around two circular tables, so as to display the light in every direction.

The upper table supports eight lamps with reflectors, and the same number of lenses; the lamps are similar to those at light No. 3, and the lenses are similar to those at light No. 1. Upon the lower table there are four lamps with reflectors. The reflectors appear to have been furnished at different periods; their diameters vary from 8 1/4 to 9 inches, and, owing to their thinness, they are bent from their proper shapes. The lantern leaks and is badly ventilated; the circular ventilators at the bottom of its frame, and the cribbed holes above, have been entirely closed up.

The dwelling-house is of frame, and contains eight rooms; it is in a good condition.

The oil is stored in a stone vault, which is in good repair.

No. 19. Five-mile Point, or New Haven light, (stationary,) is situated at the entrance to New Haven harbor, bearing from Falkner's Island light W. 1/2 N., distant 11 1/2 miles; and is serviceable to vessels passing through the sound, or going in or out of New Haven harbor. Its elevation is 50 feet, and its limit of visibility 12 1/2 miles. The tower, erected in 1805, is 30 feet high, and is built of frame; owing to its being very much decayed, the sides and deck are in a leaky condition.

The lighting apparatus consists of eight lamps with parabolic reflectors, which are placed around a circular table; the reflectors are much crowded together, owing to the small size of this table, and none of the lights are in their proper positions.

These reflectors are 13 inches in diameter, and 3 1/2 inches deep; they are attached to their lamps by means of flat hooks of copper, and are movable in every direction; one of them is very much worn, and has several indentations in it.

The dwelling-house contains six rooms; it has been built at different periods, and is owned partly by the light-keeper; is in a very bad state of repair, and leaks where its different portions have been joined together. The oil-vault is in a very good condition.

No. 20. Stratford Point light (revolving) is situated on the extremity of Stratford point, at the mouth of the Housatonic river, and bears from New Haven light SW. by W. 1/2 W., distant 9 1/2 miles. It is a guide to vessels going in or out of the Housatonic river, or passing it at night on their course through the sound.

Its elevation is 44 feet, and limit of visibility 12 miles. The wooden tower, from which the light is shown, was built in the year 1821; it is 28 feet in height; at the period of my visit it was undergoing repairs.

The lighting apparatus consists of ten lamps, with parabolic reflectors, arranged in two clusters, as in revolving lights Nos. 1 and 10; the axes of the reflectors, at the extremities of each cluster, diverge from each other 45°, and each light is placed a little without the focus of its reflector, which causes a slight convergence in the beam of reflected light; this convergence varies from 4° to 11°.

The lamps are securely attached to the tables, and the reflectors are held firmly in their positions by strong iron brackets, and are in good order.
The machinery for producing the revolution of the lights is similar to that at light No. 1; on being set in motion, it caused a half revolution of the tables every two minutes; its proper rate being 2' 15''. The light-keeper has no means of judging accurately of its rate; he has added 14 pounds to the motive-power first employed. There is no diary kept at this establishment, in which the performance of this machinery is noted. The keeper informed me that it stopped last January, owing to dust having collected in parts of it, when it was taken apart and cleaned; it stopped once, also, in the summer of 1838.

The house for the accommodation of the light-keeper is of frame; it contains five rooms, and is in good order.

No. 21. *Fairweather Island light* (stationary) is situated upon the southern extremity of Fairweather island, at the entrance to Black Rock harbor, bearing from Stratford Point light W. by S., distant 5½ miles; it serves as a guide to vessels entering Black Rock harbor, and is of great utility, owing to that harbor being much resorted to in heavy weather. This light was established in the year 1808. The present tower is forty feet high; the masonry on the exterior is of freestone, laid in courses; but it is filled in with small rubble-stone and pieces of timber; these pieces of timber are about eight inches square, and average four feet in length; they are inserted horizontally in the masonry, in lieu of stone, at a distance of four feet or less apart, and are now in a state of decay. The lighting apparatus consists of eight lamps, with parabolic reflectors, arranged around circular tables, and illuminating the space included within the W. and NE. points; the lamps are badly supported upon the tables, and the reflectors are hooked upon the lamps; in consequence of which they are out of proper adjustment. The light cannot be seen at its limit of visibility when the weather is the least hazy. The dwelling-house is of frame, and contains eleven rooms; it has been built at different periods, and leaks where the several parts of the building have been joined together. Near the dwelling, and about forty rods from the tower, there is an oil-house of stone, which is in good repair; the oil, however, is stored in the tower.

No. 22. *The Middle Ground floating light*.—The Middle ground is a dangerous shoal three-quarters of a mile in length, lying about midway between the two shores of the sound; Stratford point bearing N., distant five and a half miles; Old Field Point S. by W., distant five miles. In order to point out the exact position of this shoal, a light-boat was placed off its southeastern extremity in January, 1838; this light-boat is a vessel of about one hundred tons burden, under the charge of a captain and mate, and manned by a crew of four men; ample provision appears to have been made for the accommodation of the crew, and for the stowage of wood and water for four-months' supply, and of oil for one year. The lights are shown from two masts, which are fitted for the purpose—one forty feet, the other fifty feet in height; each lantern contains a compass-lamp, which is fitted to burn ten wicks. This vessel appears to be well calculated for the station she occupies; it must be observed, however, that, in consequence of being made to ride to a single anchor of 1,200 pounds weight, when first placed there, she has been driven
several times from her proper position, which the following abstract from her log-book will show:

"January 12, 1838.—Light-boat anchored off the Middle ground in seven fathoms water; west buoy bearing NE. ½ E., distant 60 rods; east buoy bearing NE. by N.; Old Field Point light S. by W.; Stratford light N. ½ W.; Black Rock light NW by N.; veered out 60 fathoms of chain.

January 20.—Found the vessel had drifted 60 or 70 rods to the southeast, into 10 fathoms water; the west buoy bearing NE. by E.

January 30.—It was discovered that the northwest gale had driven the vessel 1 or 1½ mile to the southward and westward, into 15 fathoms water; east buoy bearing NW. by N.; Old Field Point S. SW.

February 7.—Weighed anchor and stood towards her station; let go the anchor in 7 fathoms water, near her former position.

February 19.—Drifted 40 or 50 rods to the southward and eastward, in a northwest gale.

February 27.—Removed the vessel 60 or 70 rods to the W. NW.

March 17.—Wind from the northwest and eastward; vessel drifting up the sound.

March 18.— Took the following bearings: Mount Misery, S. by E.; Black Rock light, NW. by N.; Old Field Point light, S. by E.; vessel in 16 fathoms water.

March 19.—Spoke a sloop, and requested her to report that the light would not be shown until the vessel regained her station.

March 24.—Weighed anchor and stood towards the shoal; anchored in 13 fathoms water, Old Field Point light bearing S. by W.; Stratford light N. ½ W.; Black Rock light NW. by N.; the light was again shown.

May 24.—Found the vessel had drifted 70 or 80 rods E. by N.

June 25.—Received an anchor said to weigh 2,000 pounds, with 90 fathoms of chain.

July 10.—Moored the vessel with two anchors, in 10½ fathoms water; Stratford light N., Black Rock NW. by N., Old Field light S. by W., Northeast buoy N. NE."

I inspected the light-boat in September, when the captain informed me that one of the anchors with which she was moored had dragged, and was lying under foot.

As the utility of a light-boat depends so much upon her being constantly at her station, I have been thus particular in noticing the abovementioned circumstances, and would respectfully recommend that a heavier anchor be supplied the light-boat, in lieu of the small anchor now in use, or that other and more secure moorings be adopted. No regular account of the number of vessels seen passing this station has been taken.

No. 23. Old Field Point light (stationary) is situated on the extremity of the point of that name, and is shown from an elevation of 67½ feet; its limit of visibility is 13½ miles, and in clear weather it appears brightly in certain azimuths. The tower was built in 1828; it is 30 feet high; the masonry is of stone, rough-cast; the deck leaks through its joints, and the mortar is scaling off the walls.
The lantern contains nine lamps with parabolic reflectors, arranged around two circular iron bars, so as to show the light from S. 68° W., north-about to S. 38° E. The reflectors do not vary much from the following dimensions: Diameter 13 inches, depth 4 inches; and the lights are placed at a distance of 3 inches from their vertices; this arrangement produces a convergence of 6° in the light reflected from them, whereas a divergence of nearly 32° is required in order to distribute the light properly.

The dwelling-house is of stone, rough-cast, and contains five rooms; it requires a new coating of cement, and a new roof. The oil is stored in the tower.

Prior to the establishment of the light-boat on the Middle ground, the light-houses on Old Field and Stratford points were essential to indicate the neighborhood of that shoal; and they are still of great utility, owing to the liability of the light-vessel to be driven from her station. Should it be found practicable and thought expedient to place a light-house upon the Middle ground, the propriety of discontinuing the two first-mentioned lights will be worthy of consideration.

No. 24. Eaton's Neck light, (stationary,) upon the extremity of Eaton's neck, to the eastward of the entrance to Huntington bay, bears from Old Field Point light, W., distant 18 miles; it is of service to vessels passing it, or entering Huntington bay for shelter.

This light is shown from a height of 134 feet, and its limit of visibility is 17½ miles. On passing it upon the 9th of August, it was first seen at a distance of 7 miles, while the low light on Norwalk island was seen when distant 10 miles. This, it is understood, is frequently the case, and is attributable to the state of the atmosphere upon the high land on which the light is situated.

Eaton's Neck light was established in the year 1798; its tower is 50 feet high, and is substantially built of freestone laid in courses; it has an interior wooden stairway, which has lately been renewed.

The lantern has been newly fitted up; it contains 12 lamps and reflectors, arranged around two circular tables, so as to throw their strongest light from S. 37° W., north-about to S. 75° E. These reflectors are segments of spheres, of about 13 inches radius, and the lights are placed at different distances within their foci, producing a divergence in the light reflected of from 22° to 32°.

The dwelling-house is of frame; at the period of my visit it was undergoing repairs. The oil is stored in a stone oil-cellar, which is detached from the other buildings.

No. 25. Norwalk Island light, (revolving, white and red,) upon Norwalk or Sheffield's island, bears from Eaton's Neck light —-, distant 6 miles. It is useful to the general navigation of the sound, by pointing out the position of the reef and group of islands near which it is situated; its elevation is 40 feet, and limit of visibility 11½ miles. The tower is 30 feet high; it is built of stone, and rough-cast, and appears to be in a good state of repair.

The lighting apparatus consists of 10 lamps, with parabolic reflectors, arranged in two clusters, as in revolving light No. 10. One of the clusters of lamps shows a red light, which is produced by placing a pane
of colored glass in front of each of its lights and reflectors; two of
these panes of glass are broken.

The machinery here is similar to that at light No. 1; on being set in
motion, it caused a half revolution of the tables every 66"; its proper
rate is 2' 45". The light-keeper informed me that he had changed this
rate, owing to complaint having been made to him that the light was
eclipsed for too long a period.

The dwelling-house is of stone, and is in a good state of repair. The
oil is stored in the cellar of the dwelling and in the tower.

No. 26. Great Captain's Island light, (stationary,) on Great Captain's
island, bearing from Norwalk island W. SW., distant 10 miles, serves
to point out the group of islands in its neighborhood; its elevation is 62
feet, and limit of visibility 14 miles; but it is barely discernible in clear
weather at a distance of 9 miles; it was established in the year 1829.
The tower, 30 feet in height, is of rough stone, and is badly constructed;
the mortar used in the masonry has not hardened, and the walls are
cracked in several places.

The lighting apparatus consists of ten lamps, with parabolic reflect-ors,
aranged around two circular tables, and showing light in every
direction. The fixtures of the lamps and reflectors are the same as at
light No. 3, with the addition of a circular bar of iron, around which
the lamps are hooked. The reflectors are 14½ inches in diameter, and
average 2 pounds 15 ounces in weight; the silver is much worn from
their concave surfaces. The lights are placed near to or in the foci of
their reflectors, by which arrangement very little or no divergence is
produced in the light reflected. The condensed moisture in the lantern
occasionally freezes on the glass.

The dwelling-house, containing five rooms, is of stone, and is in good
order.

No. 27. Sand's Point light, (stationary,) upon Sand's point, bearing
from Great Captain's island SW. ½ S, distant 10 miles, is of great impor-
tance to the navigation of the sound, as it serves to lead vessels clear of
the Execution rocks, which are three-fourths of a mile to the northward
and westward of it. It was established in 1809; the tower, 40 feet in
height, is of freestone laid in courses. The lighting apparatus consists
of eleven lamps, with reflectors, arranged around two tables, so as to show
light from E. SE. north-about to SW. by S. The reflectors are of dif-
ferent curves; their diameters are 9 inches, and they average in weight
13 ounces; one of them is much worn and indented.

The dwelling-house, of frame, has been built at different periods, and
contains twenty-three rooms; it is partly owned by the light-keeper,
and, at the period of my visit, was undergoing repairs.

The oil is stored in a stone vault, which is in a good condition.

No. 28. Throg's Point light, (stationary,) situated on the southeastern
extremity of Throg's Point, bearing from Sand's point SW. ½ S., dis-
tant 4¼ miles, serves as a leading light to vessels after leaving Hart
island to the northward and eastward, or Riker's island to the west-
ward. It was established in 1826, and is shown from a temporary
wooden tower, which was built in 1835, and is now in a leaky condition.

The lighting apparatus consists of eleven lamps with spherical re-
Reflectors, arranged around two horizontal tables so as to display the light in every direction. The lamps are placed upon square stands, which are secured to the tables by means of dovetail slides. The reflectors are segments of spheres, of about 9 inches radius; they are placed so that the lights are, near their foci, of parallel rays.

The light from this establishment appeared feeble when seen by me in clear weather at a distance of 4½ miles.

The dwelling-house, containing nine rooms, is of frame, and is in a good state of repair.

On the Hudson or North river there are six light-houses, of which number five are general, and one is a local or harbor light. When the navigation in their neighborhood is closed by ice, these lights are suspended.

No. 29. Stony Point light, (stationary,) upon Stony point, on the west bank of the Hudson, is extremely useful to vessels approaching it from below, as it serves to point out a pass on the river which is difficult to be distinguished on account of the uniformity of the high land behind it. It was established in the year 1826; the tower from which it is shown is of stone, and at present is in a very bad condition. The mortar used in its construction has not hardened; the masonry over the cellar window is cracked; the stone lintel over the door is broken, and the timbers over the door-frame, and the beams and rafters of the floors, are very much decayed.

The lighting apparatus consists of seven lamps, with spherical reflectors, of the same construction as those at light No. 28, and arranged to throw the light across the channel and up and down the river.

The dwelling-house, containing six rooms, is of stone, and requires repairs; the oil is stored in the cellar of the dwelling.

No. 30. Rondout light, (stationary,) at the mouth of Rondout creek, at the termination of the Delaware and Hudson canal, indicates the entrance to the creek to vessels inward bound. The light was established in 1838; it is shown from the tower on the keeper’s dwelling, which is placed on a pier in the river.

The lighting apparatus consists of seven lamps, with parabolic reflectors, arranged so as to show the light in every direction. The oil is stored in a room in the dwelling-house, and is partly contained in casks. This establishment does not appear to be well attended to by the lightkeeper, and the dwelling is not neatly kept.

No. 31. Saugerties light (stationary) is situated on the point of the Saugerties flats, which extends into the river from its west bank half a mile, and contracts the channel for some distance above and below the position of the light. The light is shown from the keeper’s house, which is of stone, and placed upon a pier at the edge of the flat. The lighting apparatus consists of five lamps, with parabolic reflectors, arranged as in light No. 29. The lamps are fastened to tin pans, which are set upon the table; they are old and much out of repair. The reflectors are hooked upon the lamps, and their axes make an angle of nearly ten degrees with the horizontal line. The oil is stored in the keeper’s house.

No. 32. Four-Mile Point light (stationary) is situated on the extrem-
ity of a bluff point, on the western bank of the Hudson, three miles above the town of Athens.

The channel of the river runs close by this point, and is contracted by a flat, which extends far across from the opposite shore. In order to avoid the flat, vessels are obliged to run close in to the point, which is high and well defined. As the bluff itself is a sufficient guide through the channel at night, the light is not considered of much utility.

The lantern is upon the summit of a stone tower; it was newly fitted up on the first of October with seven lamps and reflectors, which are arranged around two horizontal rims or circles so as to throw the light into the reaches up and down the river and across the channel. The lamps are fastened securely to the iron circles, and the reflectors are supported in front of them by brackets.

The dwelling-house, containing five rooms, is of stone, and is in good repair.

No. 33. Coxsackie light, (stationary,) on the northeastern point of Rattlesnake island, two miles above Coxsackie landing, is useful as a guide to vessels passing through the narrow channel, formed on the one hand by the island on which the light is placed, and on the other by a flat which extends over from the eastern bank of the river. The light is shown from the keeper's dwelling. The lighting apparatus is similar to that at No. 32. Although the reflectors are new, there is an indentation at the bottom of each where its hook is soldered on.

No. 34. Stuyvesant light, (stationary,) upon the extremity of a flat on the east side of the river, two miles above Stuyvesant landing. The building from which it is shown is erected upon a pier at the end of the flat. This light is of service to vessels making it, on account of the narrowness of the channel near it.

The lantern contains five lamps, with reflectors, placed upon two horizontal tables. The reflectors are spherical, their diameters are 13\(\frac{1}{4}\) inches, and average weight 2 lbs. 6 oz.

The house is of stone, containing four rooms, and is in good order; it is placed six feet above high-water mark. The building at this place was swept away on the breaking up of the river in March, 1832, when the present keeper lost four out of a family of nine individuals.

* * * * *

In pursuance of the instruction "to inquire and report whether the present public emergencies require any, and, if any, what further additional works and improvements of the above description, and of what kind," such examinations were made as circumstances admitted, and such persons consulted who were best acquainted with the navigation within the third district, from which I am induced to recommend that the following objects be authorized. Those in Long Island sound were pointed out and strongly recommended by Lieutenant G. S. Blake, United States Navy, whose accurate hydrographical knowledge and familiarity with the wants of the navigation of the sound entitle his recommendation to the greatest weight.

* * * * *

Huntington bay, from its position and accessibility, is a place of general resort in heavy weather; but as the northerly winds here drive home,
vessels, when practicable, seek a better shelter in Lloyd's harbor, in which, although it is a place of no commerce, upwards of seventy vessels have been counted at the same time. This harbor is difficult to make at night, owing to the low sandy point at its entrance; upon which it is respectfully recommended that a light be placed.

Some systematic mode of designating the positions of buoys would be of great utility, more especially should an increase in their number be authorized. Such distinctions as will show on which hand a buoy is to be passed, whether it be on a rock, a detached shoal, or at the end of a spit, will assist even those who may be familiar with the navigation, and are particularly serviceable in narrow and tortuous channels.

To produce the best results from this, simplicity must be preserved, and, at the same time, a sufficient number of distinctions introduced. I would beg leave to suggest the distinction of colors, as being the most applicable, which displays the simple combinations of color deemed most advisable. On sailing up a sound, bay, or channel, or entering a harbor, all the buoys on spits extending from the shore, which are to be left on the right hand, are painted red; all those on the left hand, are painted black. Those on rocks, or very small shoals, around which there are channels, are painted with alternate red and black rings; these, as their color would indicate, can be passed on either hand.

On the shoals, which are included between two buoys, the lower and right-hand buoys are painted with alternate red and white rings, while the upper buoys, and those to be passed on the left hand, are black and white. The red and black colors also indicate on which hand they should be left; the white being introduced merely to designate a detached shoal. This system is applicable to all the waters of the United States; the colors red and black have been selected on account of showing best upon the water; and as all buoys are now painted, there can be no objection to it on the score of economy.

I have also examined the proposed sites for light-houses and light-boats, referred to by the fourth section of the act, and designated by my instructions as falling within the third district; and have endeavored to obtain the information necessary to determine the expediency of constructing works upon them.

1. For a light-boat of increased size on Bartlett's reef, and a light-boat in lieu of the one stationed at said island.

Bartlett's reef, off which a light-boat is at present stationed, extends 1\(\frac{1}{2}\) mile, in a southerly direction, from a small island, called Too-tree, or Bartlett's island; and lies within Long Island sound, near the Race passage; its northern extremity bearing from New London light SW., distant 3\(\frac{3}{4}\) miles. As it is passed by all vessels entering or leaving the sound through its eastern passage, as well as by those frequenting the two ports of New London and Stonington, the maintenance of a good light on or near it appears to be of the highest importance.

It will be seen, on referring to the annexed abstract from the light-
keeper's diary, that in the year 1837, 23,876 vessels were observed to pass the light-boat stationed near the reef; that the average number of 3,000 were seen passing in each of the summer months of the years 1836, 1837, and 1838; and that in the month of August last, the average daily number was 113. These vessels pursue their courses by night as well as by day, and it is estimated that one-sixth the number which actually pass the vessel, are not seen from it, on account of dark or foggy weather.

The light-boat was placed on this station in December, 1835; she is a vessel of forty-one tons burden, under the charge of a captain, and manned by a crew of five men; but does not afford room for the proper accommodation of these men, and the stowage of a sufficient supply of wood, water, and provisions. The log-book shows that the captain and a part of the crew are obliged to leave the vessel frequently, in order to procure a supply of wood and water. And it appears that, in February, 1836, when the harbor of New London was closed with ice, the crew suffered from the want of these articles, although the vessel had been but six weeks upon her station.

Owing to the position of the shoal, it is exposed to the full force of the heavy seas caused by southeast and west-southwest winds; during the continuance of which, the sea breaks over this small vessel so as to render it necessary to secure the hatches, when it is always difficult, and frequently impossible, to maintain the light.

It appears, then, that the size of this vessel wholly unfit her for the station she occupies, and that "a light-boat of increased size" should be placed upon it. A vessel of 100 tons burden, of similar construction to that now off the Middle ground, would be well adapted to the purpose.

The effect of galvanic action upon the chain-cable of the light-boat off Bartlett's reef came under my notice. In order to make the vessel ride easily to her anchors, the hawse-hole, through which the chain-cable leads, is cut in her bow, at the water-line, and it is lined with a leaden and an iron pipe; the copper on the vessel extends up to three feet above the water-line, and is in close contact with the cast-iron hawse-pipe at its outer margin. That portion of the chain which forms the hawse becomes so much oxidized in the course of four months as to be untrustworthy; and, in consequence of this action upon the cable, it parted on two occasions, and the vessel was driven from her position. To avoid the recurrence of such accidents, the chain is now frequently examined, the oxidized portions cut out, and the keys of the mooring-shackle renewed.

It is also observed, that while the wrought-iron links of the chain are so much corroded, its cast-iron studs, and the hawse-pipe through which it passes, are not acted on, and the copper on the bottom of the vessel retains its brightness. In case the action alluded to is caused by the contact between the hawse-pipe and the copper of the vessel, it will be arrested by destroying that contact; which is therefore deemed advisable.
A light-house on the west end of Fisher’s island, at a place called Race point.

This point lies to the eastward of the much-frequented entrance to Long Island sound, called “the Race,” bearing from Gull island light ——, distant ——. On reference to the annexed communication, it will be seen that in a period of eight years upwards of eight vessels have been stranded on it. Although it is feared that most of these accidents have been occasioned by want of proper care, much benefit might be derived from a light upon Race point, if the navigation in its neighborhood were free from obstructions; but in addition to the reef which extends for some distance off from Fisher’s island, the dangerous rock, called Race rock, lies at a distance of nearly three-fourths of a mile from it. It is difficult, in hazy weather particularly, to form an accurate estimation of the distance of a light; and vessels judging from the bearings of one on Race point, that they had given it a sufficient berth to clear all danger, might be decoyed upon the rocks; its erection, therefore, is not recommended.

The danger in passing through the Race appears to arise from vessels mistaking the tides; the flood, when not allowed for, cutting them so much to the northward that they run upon Race point. Any means which will point out the correct state of the tide to the navigator on approaching this passage, will prove serviceable to him; it is therefore respectfully recommended that at night, during the flood tide, a second light be shown from Gull island. The object of this light could soon be communicated to all navigating Long Island sound; and as Gull island is always made in running through the Race to the eastward, a warning will be thus placed before the eyes of those who pass it on the flood.

Communication from Captain Andrew Mather, commanding the U. S. revenue-cutter Wolcott.

"U. S. REVENUE-CUTTER WOLCOTT,

"Long Island Sound, August 4, 1837.

"The late distressing shipwreck on Fisher’s island has induced me to send the following remarks and directions to the New York Journal of Commerce for publication:

"Remarks and directions for sailing through the Horse race, east end of Long Island sound, between the southeast point of Fisher’s island and Gull island.

"Vessels bound eastward in the night generally run down near Plum island and the Gull islands; and when abreast of the latter, they steer the sound course, which is E. by N.; and too many of them are not aware of the strength and course of the flood tide. The first half-flood sets NW., the last half about W. NW.; consequently, when steering E. or E. by N., they have a strong tide on the starboard bow, which cuts them over to the northward; and instead of making, as they supposed, an E. or E. by N. course, they are making a NE. by E. or NE. course, which often carries them on Race point, from which runs far out a reef of rocks under water."
"Since I have commanded the revenue cutter on this station, (1829,) I have assisted eight vessels ashore on Fisher's island, six of them were on Race point; all of them on nearly the same place, or within a space of not more than a hundred yards; and during that period have known several more to go entirely to pieces, and in some instances with loss of life, and a great loss of property.

"From conversation with the masters and pilots of those vessels, I have been led to believe the cause of most of these accidents may be attributed to their mistaking the tides.

"Vessels bound eastward through the Race, in the night, when abreast of Gull Island light, with the tide at flood, and a leading wind, should steer E. by S. or E. SE. until Gull island light bears W. by N., and preserve that bearing until they see Stonington light over the low land of Fisher's island; they are then clear of Race point and Race rock.

"The spring tides in the Race run about five knots per hour; the neap tides about four knots. High water on full and change at 11 o'clock."

A light-house on the northwest point of Gardiner's island, Suffolk county, Long island.

Gardiner's island forms the eastern shore of the bay of the same name, which lies near the northeastern end of Long island, and to the southward of Plum and the Gull islands; its northern end is the termination of a low sandy beach, from 300 to 500 feet in breadth, which extends three miles into the bay, in a northwesterly direction.

At its north point there is six fathoms water close to the beach; and to the westward three fathoms water is found at a distance of 100 feet from the shore; but a shoal extends out to the eastward, upon which vessels coming from that direction, and not knowing their danger, are liable to run.

The lights on the Gull and Plum islands (the former bearing N. 31° E., distant 8 1/2 miles, and the latter bearing N. 52° W.) are at present the best guides in running for this point, which, owing to the lowness of the land, is impossible to be distinguished at night at any distance.

In order to determine the degree of danger attending the navigation in this quarter, I have endeavored to ascertain the number of vessels stranded upon Gardiner's point, and the circumstances under which they came on shore. With this view, access has been had to the depositions of witnesses in a cause pending in the court of common pleas, county of Suffolk, Massachusetts, which relates to the brig Malaga, stranded on this point in July, 1836. It appears that in a period of sixteen years upwards of twelve vessels have stranded upon this part of Gardiner's island. The circumstances under which some of these disasters occurred, were such that a light would not have averted them; but I have been informed that, among others, the five sloops of Riverhead would have received from it a timely warning of their danger.

The amount of trade belonging to the ports in the neighborhood of this point is shown as it is passed by these vessels and by others seek-
ing shelter in Gardiner’s bay, and as a light would contribute much to
their convenience as well as safety, I would respectfully recommend its
establishment. * * * * * * * * * *

A light-house or light-boat on Execution rock, Long Island sound.
The Execution rocks lie near the head of Long Island sound, the
eastern extremity of the reef bearing from Sand’s Point light N. 21°
W., distant three-quarters of a mile; and are passed by the majority of
the vessels engaged in the extensive trade through the sound. In clear
weather the light upon Sand’s point is an excellent guide for the southern
channel, but it cannot be depended on when the weather is thick and
boisterous; and to those passing to the northward of the reef, it affords
but little assistance at any time. On this account, a light and bell upon
the reef would contribute greatly to the safety of the navigation. Both
a light-house and a light-boat have, at different times, been suggested
for this purpose; but the establishment of the former appears the most
advisable, from the following considerations:

1st. A light-house will accommodate a more perfect lighting apparatus,
and, consequently, a more brilliant light can be shown from it than from a
light-boat.

2d. From its not being liable to change of position, vessels can run
for it with greater confidence than for a light-boat, which is liable to that
change.

3d. From being placed on the reef, it will be a better guide for both
passages around the rocks than a light-vessel anchored near the shoal.

4th. It will prove more economical in a series of years: for, assuming
the cost of a substantial building to be $40,000, annual repairs $500,
maintenance of light and salaries of keeper and assistant $1,500; and
the cost of a light-boat, which is required to be renewed every five years,
to be $10,000, maintenance of light and salaries of captain and crew
$2,600 per annum; and allowing interest on the difference of the appro-
priations for the two objects, in a period of twenty-five years there will
have been expended for the light-house the sum of $102,500; for the
light-boat $115,000, leaving a balance of $12,500 in favor of the former;
and when, at the end of this time, it will be necessary to renew the boat,
the tower will be standing.

The chart shows the result of the examination of the reef and shoal;
the rocks to the eastward are masses of stratified gneiss, having indica-
tions of being parts of a continuous ledge; while those to the westward
are in small detached fragments, having been broken probably from the
larger masses and driven to their present positions by the force of the
sea in easterly gales.

As there is every indication of a site for a secure foundation being
obtainable, I would respectfully recommend that the establishment of a
light-house be authorized, and, on account of being most serviceable to
vessels approaching it from the eastward, would suggest the eastermost
extremity of the reef for its position. The limit within which it should
be placed to be most useful is traced upon the chart and marked. The
exact site should be determined on by an engineer.

5th. A light-house on Teller’s point, on the Hudson river.
Teller’s point, on the eastern bank of the Hudson, forms the northern
boundary of the cove above Sing Sing; a few rocks lie off the pitch of the point, and a shoal extends from it to the westward for about half a mile; between the edge of the shoal, on which there is twenty feet water, and the opposite shore, there is a good channel about one mile and a quarter in width, in which from six to six and a half fathoms can be carried; and from this depth the water shoals gradually to three fathoms. On this account, vessels in beating past the point can always be guided by the lead, and a light is not required on Teller's point as a beacon for the shoal.

The point opposite, on the western side of the river, being high and peculiarly marked, is the guide for vessels standing up the river through Tappan bay. I have been informed by pilots that Teller's point is more in the direction of the channel than the high land alluded to, and that a light upon it would be a better leading-mark than that now used; but the advantage proposed to be gained by the light does not appear sufficient to permit me to recommend its establishment.

6th. A light-house on the Hudson river, at a point about one mile south of the village of Athens.

The point referred to in the law is understood to be the point of the flat extending about half a mile from the west shore of the Hudson, off Brandon's cove; the channel, from this point to the flat off the opposite shore, is from one-quarter to one-third of a mile wide, having nine fathoms in the middle, and shoaling gradually to three fathoms on either side, when suddenly, the flat is made. The shoal on the eastern side of the river does not extend as far from the bank as the western shoal, and it narrows gradually until it reaches Merino point, half a mile below the city of Hudson. The channel is an excellent beating-channel for sloops and other vessels, and a light upon the point of flats would add greatly to their convenience; but when the little danger attending the navigation and the probability of similar cases being numerous in the rivers of the United States are considered, the propriety of embracing such cases in the lighting establishment would appear doubtful.

The only appropriation falling within the third district is as follows:

“For the erection of a light-house on the northern islet, in Fisher's sound, near the northwest end of Fisher's island, three thousand dollars.”

* * * * * * * * * * * *

By a clause in the third section of the act, the officers making the inspections under it are required also “further to report whether, in their judgment, the public interest requires any modification of the system of erecting, superintending, and managing the light-houses, light-boats, &c., and if so, in what particulars.” The fulfilment of this duty is entered upon with diffidence, after a due consideration of the magnitude of the interests affected by the proper organization, efficiency, and economical administration of the establishment in question.

In order to present the subject properly and in a connected form, it may be well to take a hasty review of the progress and management of the light-house establishment from its origin to its present organization, as detailed in authentic public documents.

It appears that immediately after the formation of our Government, and prior to the year 1789, the few light-houses then existing were
maintained at the expense of the States in which they were situated. By an act of Congress passed in 1789, the expense of their maintenance was assumed by the United States, and their management confided to the Treasury Department, with which it has ever since remained. The first light-house erected by the General Government was that upon Cape Henry, in 1791; and from that date to the year 1800, eight new lights were established, making the total number 16. They were placed upon the most frequented and dangerous points of the northeastern and middle portions of the Atlantic coast; three of them are within the present third district, and will be more particularly referred to. Prior to the year 1812, the number of light-houses had increased to 49, and their establishment extended along the southern coast of Louisiana; the buildings were generally constructed by contract, and were inspected, before being received, by the superintendents of the districts in which they were situated. The lanterns were furnished with the common spider lamps, without lenses or reflectors; and the oil for their use was stored in the custom-houses, and delivered at the light-houses as it was required.

In the year 1812 an improvement was made in the lighting apparatus, by the substitution of argand lamps for the common lamps then in use, and the addition of metallic reflectors. This was effected by a contract entered into by the Secretary of the Treasury with Mr. Winslow Lewis, of Boston, by which the United States purchased of Mr. Lewis his "patent-right to the plan of lighting light-houses by reflecting and magnifying lanterns," for the sum of $20,000; the contractor agreeing to fit up, according to said plan, all the then-existing light-houses, and those that should be established in the following two years, so that the new apparatus should give a more brilliant light, with a supply of one-half the oil formerly consumed; the expense of materials, making, and fitting the apparatus being borne by the United States. The reflector then introduced, and to a great extent still in use, is made of copper, plated with silver on its concave surface, which is modelled into the shape of a paraboloid; this reflector is similar in form and material to those placed in the light-house at Inch Keith in the Frith of Forth, in the year 1803, and is similar in form to those composed of facets of mirror glass, which were in use in the Scottish lights as far back as the year 1786. The lens employed in conjunction with the argand lamp and reflector is a mass of impure glass weighing over 8 lbs., and has already been described in the account given of light No. 1.

Up to the year 1822 the number of light-houses had increased to 70; they were supplied with oil, &c., under a contract entered into with Mr. Lewis, who received from the United States one-half the oil previously consumed in their maintenance. Contracts for oil have since been made with other individuals; and differ from this, by substituting a certain sum for the maintenance of each light, in lieu of the former mode of payment.

At the commencement of the present year, there were in operation upon the sea-coast, and the shores of the great inland waters of the United States, 204 light-houses, together with 28 light-boats, which are placed near dangerous reefs and shoals, where it is difficult or impossible to procure a secure foundation for a permanent building.
The system under which this establishment has thus increased, and is at present conducted, it is now necessary to examine; and, in so doing, the facts elicited by the examination of the lights will be referred to, in order to show its practical operation; seeming defects in the system will be pointed out, and, in obedience to my instructions, such propositions made for its modification as the public interest may appear to require.

The authority for establishing a new light-house is derived from the act of Congress making the appropriation for its erection; such appropriations are generally made upon the representations of petitioners that by the object proposed the navigation in its vicinity will be benefited. Prior to 1837, no strict inquiry appears to have been instituted in order to ascertain the necessity for establishing the new lights applied for, the amount of benefit to be derived from them, or the injury liable to be produced by their multiplicity; and as the check upon improper applications, created by the imposition of a direct tax upon vessels passing a light, does not exist: in this country, it is not surprising that light-houses have been applied for, and placed in situations where the service rendered by them has not warranted the expense of their construction and maintenance; and by those acquainted with this mode of application, it will easily be understood why the comparatively safe shores of populous districts are seen in many instances studded with lights, while on the unsettled though much frequented and dangerous portions of our seacoast they are of much rarer occurrence. This defect in the light-house system has already attracted the attention of Congress. By one of the sections of the act making appropriations for new lights in the year 1837, it was provided that, before the improvements specified in the act should be commenced, an examination of their proposed sites should be made, and their usefulness inquired into and reported favorably upon by the Board of Navy Commissioners. By the operation of this provision of the law, the construction of 31 of the proposed buildings, involving an expenditure of $168,700, was suspended; but while a strict examination of this nature will arrest the construction of buildings of little or no utility, something further appears to be required in order to render the system more equal in its operation over the different portions of the country.

The appropriation for a building is not founded on an estimate made after having the proper site selected, and the plan of building calculated for it drawn up; but the building is made according to the appropriation and site. In some instances, the appropriations have not been sufficient, and works of real importance have been delayed; in others, unsuitable buildings have been erected, in order to bring their cost within the sum to be expended. A light being authorized, the site for it is selected by the superintendent of the district under which it falls; this superintendent is always a collector of the customs, but the duty which thus devolves on him often requires the peculiar knowledge both of the engineer and the seaman. The nature of the foundation, the action of the sea and of the currents in its immediate neighborhood, are among the subjects which require the consideration of the former; while the selection of that position from which the light would afford the greatest assistance to the mariner, is peculiarly the province of the latter.
The destruction of much public property might have been prevented by a more judicious selection of these sites, and the public interest evidently demands a reform in this particular. In most instances, the plan of the building is furnished from the office of the Fifth Auditor, and the superintendent of the district advertises for proposals to build, in accordance with it. A suitable mechanic is then employed to see that the work is properly done, and upon his certificate, it is accepted. It cannot be denied that, under this system, many buildings have been badly constructed. Within the third district, it is seen that the houses or towers of lights Nos. 4, 7, 21, 23, 26, 28, and 29, are of this description; and the beacons which were destroyed at Black Rock and Bridgeport also afford striking instances of the misapplication of the public money. All these works, built under the economical system of contract, and intended to be permanent, have not stood the proper test of true economy. The check upon contractors imposed by the supervision which has been referred to, has had but little effect in securing good workmanship or the faithful performance of their contracts; and it is worthy of remark, that the oldest buildings are now in the best condition—the towers, in particular, of lights Nos. 9, 14, 24, and 13. The three first, erected at the close of the last century, afford a striking contrast to many of those of very recent construction.

The light-boats are built under the same contract system, according to plans furnished from the office of the Fifth Auditor, and it is found that on the southern coast, particularly, they are so much injured by dry-rot in the course of four years, "as to cost nearly as much in repairs as would build new vessels." The unseasoned state of their timbers is the probable cause of this rapid decay, and indicates the proper remedy to be applied.

The proper adaptation of these vessels to their stations has not always been attended to; this is observed in the instance of light-boat No. 15, which is wholly unfit for the position she occupies, and a want of proper forecast has been shown in the provision for mooring light-boat No. 22. These may be exceptions to the general system, but, having occurred under it, they are deemed worthy of attention.

A light-house being under contract, separate proposals are at the same time received for fitting it agreeably with Mr. Lewis's lamp and reflector, and everything necessary to keep up the light. There is no copy of the specifications of the patent taken out for this apparatus in the office of the Fifth Auditor, but it appears that in thirty-four of the light-houses first fitted up by Mr. Lewis, lenses were employed with the smallest class of reflectors. Within the third district, they are now in use in light-houses Nos. 1, 17, and 18, and were formerly employed in Nos. 10 and 17. The object of these lenses appears to be to decrease, by refraction, divergence of that portion of the direct rays from the lamp which falls upon them; but, at the same time, they receive and refract the rays already reflected from the mirrors. The effect these lenses are intended to produce, adds very little to the light, and if it be considered that they are very thick, and generally of very impure glass, it will appear that they must absorb much more light than is made up by it;
and when placed so as to increase greatly the divergence of the reflected light, as at lights Nos. 1 and 17, they are of still greater injury.

The use of these lenses has been discontinued, as the apparatus to which they belonged has required renewing.

The paraboloid form is generally considered the best that has yet been adopted for the reflectors of light-houses, that figure having the property of reflecting, in parallel rays, the light radiating from its focus, and producing a divergence or a convergence in the reflected rays, according as the flame from which they proceed is nearer to or farther from the vertex of the reflector than the focus. In order to produce the best results from its employment, great care and accuracy are required—

1. In modelling the reflector to the proper form, in securing the permanency of its figure, and giving it a good reflecting surface.

2. In adapting the lamp to the reflector so that its flame may be in the position which will produce the proper divergence of the reflected light.

3. In placing the axis of the reflector in the direction in which the strongest light is required, which is generally on the horizontal line.

Let us examine how these conditions have been fulfilled under the present system:

1. It has been seen that, in some instances, reflectors of a different form from that required by law have been furnished and received. At lights Nos. 24, 27, 28, 29, and 34, they are spherical; and those in Nos. 1, 2, 5, 17, and 18, are so much bent that it would be difficult to determine the forms originally given them. This latter defect is owing to the great lightness of the reflectors, as many of them are made of metal of which five and even eight square inches weigh but a single ounce. In the last-mentioned lights, together with Nos. 4, 6, 11, 16, 19, and 26, the reflecting surface of the mirrors is injured by the abrasion of the silver. In some instances this is effected in the ordinary process of cleaning; and in others it is occasioned by the friction required to free it from the lampblack deposited, owing to the shortness of the tubeglasses.

2. The reflectors, in some cases, have not been placed in the positions calculated to produce the best effect; the most remarkable instances of this occur in lights Nos. 19, 23, and 26; but the fixtures in many more of the establishments are such that they are easily put out of adjustment.

3. Owing to the imperfect mode of securing the reflectors to the lamps, and the improper fixtures of the latter, which have already been alluded to, it is found that in lights Nos. 1, 3, 7, 12, 17, 21, and 31, the axes of the reflectors are not on the horizontal line, and are generally elevated above it. By this arrangement, the strongest portion of the reflected light is thrown upwards, and can never meet the eye of an observer from the water.

It is apparent, then, that under the present system a moderate degree of efficiency has not been secured, even in the simple catoptric instruments now in use; and while, by other nations, the aid of science has
been called in to render more perfect the different methods of illumination, many of those intrusted with the fitting up and management of the light establishment in this country have been, in a great measure, ignorant of the nature of the instruments which are its very essence.

The manner in which the oil, wicks, and tube-glasses are supplied, is explained in the accompanying letter from the Fifth Auditor. These articles are delivered by the contractors at the different light-houses, generally in the month of June or July. Should the lighting apparatus require repairs at this time, they are made while the oil vessel is waiting, and are, consequently, done hastily and in a very imperfect manner.

Within the third district it was found that the winter oil last delivered had not been tested in any one establishment; and in case oil of bad quality has been furnished, the fact will not be discovered until the oil is required for immediate use. Such was the case, I was informed by the light-keeper at the Morgan’s Point light, in the winter of 1836–37. The report of the keeper of Block Island light for the year 1837, also shows that the oil consumed there throughout the last quarter of that year was of the second quality; and in the report of the keeper of Sand’s Point light for the same year, the oil is stated to be not of the first quality. By testing the oil immediately on delivery, and according to a certain standard, this difficulty would be removed, and justice done to both contracting parties.

The modifications required to render the present light establishment more effective, are suggested by the operation of the system under which it is organized. They have already been touched upon in the foregoing examination, and will now be briefly recapitulated.

1. More accurate information respecting the utility of a light appears to be required before its establishment is authorized. This will be obtained by the examination of the locality by persons possessed of the requisite hydrographical and nautical information, and by inquiring into the magnitude of the trade proposed to be benefited.

2. The exact site for the building should be determined on, upon examination by an engineer and seaman conjointly; in order that the position which will best show the danger to be avoided may be selected, and, at the same time, that a proper foundation for the building may be secured.

3. The appropriation should be based upon an estimate made after the plan of building suited to the locality, and the nature of the lighting apparatus, have been determined on.

4. The faithful construction of the light-houses, light-boats, and beacons should be better provided for.

5. More knowledge and care are required in the construction, adjustment, and repairing of the lighting apparatus, and in adapting it to the different light-stations; and provision should be made for the introduction of such improvements as may be, from time to time, suggested in the illuminating apparatus.

6. The inspection of the oil on delivery, so as to receive a supply of that article of the best quality, is of the highest importance. It may be
proved by the oleometer, an instrument founded on the known difference in the specific gravity of sperm and whale oil, and which has already been adopted by one of the States as the standard for the purity of the former, and it may be subjected to trial by reduction of temperature and by burning.

7. A more vigorous superintendence and more rigid inspection are required; to obtain which, the number of district superintendents should be decreased, and appointments made with the especial view to that service. The keepers of the light-houses should be made acquainted with the nature of the apparatus they have in charge, and be instructed in the best manner of preserving it in good condition.

8. A more uniform system of buoyage is required, and its benefits should be equally extended over the navigable waters of the Union.

In order to obtain these requisites, I would most respectfully recommend that, in addition to the present head of the light establishment, the offices of inspector, engineer, and optician be created:

That the office of inspector be filled by an officer selected from the naval service, whose duty it shall become to examine the localities proposed for new lights; to select the sites for light-houses, in conjunction with the engineer; to determine on the positions in which to place the light-boats; and to inspect, periodically, the light-houses, light-boats, and buoys:

That the office of engineer be filled by an officer of the corps of engineers, whose duty it shall be to examine and select the sites for proposed buildings, in conjunction with the inspector; to form plans and make estimates for buildings, and supervise their construction and repair:

That the light-boats should be constructed of the most approved materials, and of the best materials, at the different navy yards, and delivered to the light department when in readiness to be placed upon their stations:

That the office of optician be filled by an individual possessing suitable attainments, whose province it shall be to decide upon the apparatus proper for each station; and who shall superintend the making of the lamps, reflectors, and such other instruments as may be required in his department, and make periodical examinations of the different light establishments.

I would, also, respectfully recommend that a depot for oil and other supplies for the lights, and for the materials for buoys, be established in each of the present districts on the coast; and that an officer be detailed from the naval service, to whom the immediate superintendence of each district shall be confided; that it shall be the duty of each district superintendent to make himself acquainted with the navigation of his district, and ascertain the facilities it requires; to visit frequently the different light-stations, and ascertain that they are in good order and properly kept; also, to inspect the oil and other supplies on delivery, and distribute them as required at the lights, and superintend the buoyage of his district; and that for these purposes a small vessel be provided and placed under his control; and that all the above-mentioned officers be under the direction of the head of the light establishment, to whom all
reports shall be made, and whose duty it shall be, as at present, to make
the necessary contracts, and exercise a general supervision.

All of which is respectfully submitted

Your most obedient servant,

GEORGE M. BACHE,

Lieutenant, U. S. Navy.

Hon. Levi Woodbury,

Secretary of the Treasury, Washington.

A.

Treasury Department,

Fifth Auditor's Office, August 14, 1833.

Sir: I have just received your two letters of the 11th instant, and it
gives me great pleasure to transmit, as I now do, the information you
have desired.

1. When a light-house is authorized to be built, the proper superin-
tendent (always a collector of the customs) is directed to select the most
suitable site, and to purchase a few acres of land for the accommodation
of the establishment, if they can be had at a reasonable rate. If the
owner demands too much, the superintendent is instructed to apply to
the legislature of the State for an act to condemn and sell off the land
we want, at a valuation to be fixed by two or three disinterested men.

2. On obtaining a title for the site, a plan of the building, suitable
to the place and the appropriation, is furnished him by this office, with
directions to advertise for proposals for two or three weeks to do the
work by contract. He sends the proposals to this office, and the lowest
is always accepted, if the party has not deceived us previously. He is
then directed to enter into a contract with the party, and to appoint a
suitable mechanic to oversee the work daily as it progresses. On the
certificate of this mechanic that the work is faithfully done, the super-
intendent makes payment. Separate proposals are at the same time
received for fitting up the light-house, agreeably to Mr. Lewis's lamp
and reflector, and with everything necessary to keep up the lights.

3. Light-boats are built in the same manner. The plan is forwarded
by this office to the proper superintendent, who advertises for proposals,
and the contract is given to the lowest bidder. Sometimes I advertise
in the Globe, and receive proposals directly at this office for building
both light-houses and light-boats.

4. After light-houses are built, they are supplied with oil, wicks, tube-
glasses, and everything necessary for keeping them lighted, and the
apparatus is also kept in repair by persons who contract for this purpose,
for five years at a time. There being no certain mode for testing the
oil but by actual use, the keepers are instructed, if it is not of the best
quality when they try it, to notify the proper superintendent, who calls
upon the contractor to take it away and supply good oil. I send you a
copy of this contract as entered into at the beginning of the present
year, and also a copy of the standing instructions to the keepers. You will see by this contract that the contractors are bound once a year to examine and report the condition of the light-houses to me. Besides this examination, the superintendents are directed to examine them in June, yearly, and report their condition in time to make the repairs before cold weather. On receiving their reports of the repairs necessary, I forward instructions to have them made. There is but one keeper to each light-house, except it be on the coast of Florida and of Louisiana, where we allow an assistant keeper. The keepers are appointed by the President. On board the light-boats of the largest class we allow a master and mate, with five or six hands, and a cook. The captains are allowed $700 a year, and the hands the wages that are given in the merchant service at the nearest port to them, with twenty-five cents in lieu of a ration a day. The vessels of a smaller class are allowed a master only, and three or four hands. The master receives $500 per annum, and the hands what is given in the merchant service as above.

5. When it is necessary to suspend a light, either in a light-house or light-boat, in order to repair it, the superintendent gives public notice.

The distance the lights can be seen has been derived from the concurring opinions of two or three respectable ship-masters. I have lately directed, however, that the distance they can be seen on the eastern coast should be ascertained, mathematically, by Professor Paine, of Cambridge College, near Boston. The keepers of the light-boats, as well as the men, find their own provisions, so they can waste nothing belonging to the public but oil, and the superintendents supply that at short intervals, and generally know that it is consumed on board.

The keepers of light-houses can waste nothing but oil, and the risk of that is altogether with the contractors, for they are bound to supply all that the light-houses may require, without regard to quantity.

I believe I have now given you full information as to every point which it appears to be material for you to know, and I hope it will be of advantage to you. The superintendent can give you much information as to details.

In answer to your second letter, as to the estimate to be made, I have to state the purchase of the land always comes out of the appropriation for building, though I think your duty would be performed in estimating for the building only.

I have the honor to be, very respectfully, your obedient servant,

S. PLEASONTON.

Lieut. GEORGE M. BACHE, Newport, R. I.

TREASURY DEPARTMENT,
Fifth Auditor's Office, November 2, 1838.

Sir: In answer to your letter of yesterday's date, I have to inform you that I am not in possession of a copy of Mr. Lewis's patent for his apparatus for light-houses, so as to ascertain whether the lenses to which you refer were a part of the patent; nor is the apparatus particularly
described in the contract entered into with Mr. Lewis by Mr. Gallatin, then Secretary of the Treasury.

On referring to the accounts of General Dearborn, who was collector at Boston in 1812, and to those of his son, in 1815, who succeeded him, I find that Mr. Lewis was paid for fitting up 34 light-houses with nine-inch reflectors and lenses, and for fitting up the residue with fourteen, sixteen, and eighteen-inch reflectors, without lenses; from which it is evident that the lenses were included in the patent, and were used by Mr. Lewis only with the nine-inch reflectors. The lenses, however, have, from time to time, been discontinued, as the apparatus required renewing, with the exception of the two or three you mention, and the one at Old Point Comfort.

In the 172 light-houses which I have had built, I have not employed any of the lenses, having caused them to be fitted up with the reflectors only.

I have the honor to be, very respectfully, your obedient servant,

S. PLEASONTON.

Lieut. GEORGE M. BACHE.

Report of Lieutenant William D. Porter, United States Navy, upon the condition, usefulness, and modification of the system of erecting, super-intending, and managing the light-houses, light-boats, buoys, and beacons, in compliance with the 3d section of an act of Congress passed July 7, 1838, entitled "An act making appropriations for building light-houses, light-boats, beacon-lights, buoys, and making surveys for the year 1838."

SIR: As the lights along our Atlantic coast and within our numerous lakes, bays, and harbors, have become too numerous for one person, without assistance, (however industrious or intelligent he may be,) to supervise or bring into a proper system of successful operation, under a judicious and economical arrangement, it therefore appears to me that the inconveniences and dangers which may have arisen from a defect of this nature may be obviated by creating a department exclusively for this purpose, and unconnected with any other, having at its head an officer with suitable qualifications, with others under him attached to different districts, who, by furnishing to the head of the department all necessary information, and acting in obedience to his orders, will give uniformity and efficiency to the whole system. By the adoption of this system the head of the department will be enabled to give authentic, prompt, and extensive information to all interested for the security of life and property exposed to the dangers of the ocean and in the inlets on our coast. I offer the foregoing suggestions to create a department, on the ground of the established fact, that nothing so much tends to the able performance and despatch of duties as a judicious division of them among officers of activity, zeal, and intelligence. It is by these means that prompt, certain, and full information can be obtained and disseminated by a department so organized. It would be out of place in me to offer
any detailed plan for organizing the department aforesaid, inasmuch as it will belong to others, whose elevated station, experience, and superior qualifications are much better adapted to the undertaking. It may, however, be permitted for me to suggest that the head of such a department might have not only the supervision and direction of the light-houses, light-boats, beacon-lights, buoys, &c., and the officers appertaining to the same, but that, in addition thereto, it should be his duty to make contracts with the various individuals within the range of his authority, whom it may be necessary to employ to meet the objects of Government, and benefit and secure that portion of our commercial and maritime interests for which it is especially intended; that he should have the settlement of all accounts with those having relations with the department; and in all cases where repairs or new light-houses, light-boats, buoys, &c., may be required, that plans and proposals for the same shall be submitted to him for his consideration and decision, under such regulations as Congress may prescribe. In order that the head of the department may have every light to enable him to make a judicious selection of sites, &c., it would be very advisable to have associated with him in these duties a skilful engineer and optician. Under the system herein proposed, frequent inspections of the light-houses, light-boats, beacon-lights, and buoys, would be advisable. I therefore recommend that, if this plan, in whole or in part, be adopted, vessels of a light draught of water be purchased or built, and placed under the command of the district inspectors; these vessels could be constantly and profitably employed, when not otherwise engaged, in delivering all the articles necessary for the light-houses, light-boats, beacon-lights, placing and replacing the buoys. By this arrangement the department will not have to acquire information from irresponsible persons, or rely upon the representations of contractors, light-house or light-boat keepers, petitioners, and owners of lands, whose views are seldom elevated above selfish considerations.

The present system of placing different districts under the care of collectors of customs, was, perhaps, suitable to the state of things at the period of its adoption, and was possibly a useful modification of the plan which preceded it; but the increase of commerce, and the changes produced by time, place the existing system in the same relation to the present times as the ancient one bore to the period of the last modification. The prematurely dilapidated and decayed condition of some of the light-houses and light-boats evidently manifest a defectiveness either in the manner of contracting for them, or a want of skill in the architects or constructors. The principle which has heretofore prevailed, of giving the contract to the lowest, without taking into consideration the best applicant, though it may appear to be founded upon the principles of economy, will not always prove to be the most advantageous. The anxiety of individuals to secure the contract may induce them to offer terms which cannot be honestly complied with without a loss, to save which, the work must be either slighted, or unsuitable materials must be employed. It may be thought that a departure from the principle of giving the contracts to the lowest bidder would open a door to favoritism, but I would suppose that little apprehension of this kind could exist with
regard to a department conducted by individuals who owe their situations to irreproachable character and acknowledged talents. But, in either case, whether the contracts be given to the lowest or best bidder, I esteem it important that the Government should construct and build the light-houses, boats, and beacons under the inspection of competent engineers and architects. The contractors are generally bound down to so low a sum in building, &c. that they are compelled, to save themselves from loss, to use materials of the cheapest, and generally of the worst kind. I, therefore, recommend that the present system of contracting for the erection of light-houses be abolished, and their erection placed under the management of a competent engineer. I will here take occasion to observe, that the main tower erected on Cape Henlopen, years previous to the American Revolution, is at present strong and solid, without crack or flaw in the workmanship, and still exhibits evidence of continued durability, whereas the tower at Fire Island inlet, built apparently after the model of that at Henlopen, is of modern date, has undergone several repairs, and is yet leaky.

The essentials in building light-houses are economy, durability, and usefulness. The first and second essentials cannot be obtained in the highest degree under the present contract system; this is fully proved by the condition of the modern buildings. The last and greatest object has also failed, as the object of a light is not only to be seen at the greatest distance the rotundity of the earth will permit, but to be seen at that distance distinctly; this object has not been attained. Few of the light-houses in the fourth district can be seen distinctly as far as the rotundity of the earth will admit.

The following important lights can be seen at the distance herein mentioned, but not so distinctly as to free the mind of the observer of all uncertainty with regard to the identity of the light: Sandy Hook light, 13 miles; Navesink light, 20 miles; Cape May light, 12 miles; Cape Henlopen light, 18 miles; Cape Henry light, 16 miles.

I do not attribute the defects in our lights to an insufficient number of lamps, but to the manner in which the lamps and reflectors are arranged, without an accurate observance of optical principles. There are cases in which some lamps may be usefully and economically dispensed with; in other cases, the reflectors are too remote from each other to produce a proper and powerful condensation of light. The lanterns generally in the light-houses in this district are sufficiently large, but, in consequence of being badly lighted, and the interior surface of the dome, stanchions, and sashes dark, the rays of light are absorbed and not reflected. The crossbars of the sashes also stand in too high relief from the plane of the glasses, whereby a considerable quantity of the rays of light are obstructed; the surfaces of the glasses are also in many cases very uneven, which refracts the light so as to weaken its effect upon the eye of the observer.

The light-boats in the bays and rivers of this district do not appear to me to be constructed upon the best plan to defend them from the floating ice. I would, therefore, invite attention to the plan of a vessel invented by Commodore James Barron, the bottoms of which are solid, and would effectually resist the heavy and sharp bodies of ice which they
must occasionally encounter, and they would not be injured by the ordinary accidents which lighter vessels could not resist.

I respectfully refer you to the letter (accompanying this report) of the superintendent of the Delaware breakwater, addressed to me, on the utility of a fog-bell on the breakwater, which letter is fully in accordance with my views. I would recommend its erection about the centre of the works, so that its warnings may be simultaneously heard at either extremity of the breakwater. I also recommend that a beacon-light be erected on the eastern extremity of the works, and, to designate it from the beacon-light on Cape Henlopen, it would be proper to have it a colored light. After its erection, the present small light on the superintendent's dwelling can be dispensed with.

I also suggest the utility of a beacon-light on Drum point, which forms the mouth of the river Patuxent. The necessity of a light at this point is very great, as all vessels bound up or down the Chesapeake put in at this place during the winter to seek protection from the floating ice; and as the entrance is formed by a low sand spit, which cannot be seen at night, vessels are often obliged to anchor outside the above-mentioned point until daylight, and, in consequence, are often driven on shore in heavy and adverse winds.

The present sites for light-houses in the fourth district have been judiciously selected, and when the light-houses on Sharp's island, in the Chesapeake bay; the light-house on Reedy island, in the Delaware river; the light and beacon at South Amboy, New Jersey; the beacon-light at the Corner-stake, (so called,) between Elizabeth-town point and Shorter's island, and the small light on Shorter's island, with the lights I have recommended, shall have been completed and properly attended to, a central link will be formed in the chain of lights along our coast, which will give the advantages and security to our navigation which are contemplated. The buoys that have been heretofore placed appear to me to be very useful at the different points and shoals which they are to designate, and I have found all those generally in good order that have been placed under the charge of the commanders of the revenue cutters, for which duty they receive an extra compensation of $300 per annum.

The buoys at Assateague inlet are in bad order, and not generally placed in such a manner as to designate the course of the channel.

The light-boats and some of the light-houses, from their location, could render great service to vessels in distress during the winter months, and after heavy storms at other seasons of the year, if supplied with proper life-boats, and crews to man them. By this arrangement, many lives would be saved, great distress alleviated, and the revenue saved to the country would sufficiently cover the expenses of boats and the wages of extra men. In adopting this suggestion, it will be necessary to increase the crews of the light-boats to ten men, and at the same time employ as their keepers seamen who have a knowledge of the management of boats in bad weather. Heretofore, most of the light-boats have been kept by men (landsmen) who have farms within their vicinity, and who have either employed others at low wages to attend to their duties, or wholly neglected them. It appears to me that it would be to the interest of the Government, and to all who may be concerned, to place the light-boats
and houses under the care of old seamen, or warrant officers of the navy or revenue service, who, by long and faithful service, have become too old for more active duty. Men who have for a long time followed the sea appreciate the advantages of good lights; they would feel it a duty they owe to their brother mariners to keep their lights in good order. In my visit of inspection, I always found it the case that light-houses or boats kept by seamen or pilots were in good order. It is to the hardy, industrious, and much-neglected mariner that our country is indebted for much of its prosperity and luxuries in times of peace; and during the wars in which we have been engaged, they have always been foremost in their country's defence. By their untiring industry and indefatigable perseverance we are enabled to defray a great portion of the expenses for the support of the different branches of our Government. The mariner, from his occupation, is entirely cut off from a direct representation in the legislature of his country. Mostly on the bosom of the boisterous ocean, he is an exile from his country, wife, children, and friends; yet this very separation endears him to the land of his birth, and he feels as great an interest in the prosperity, happiness, and independence of his country as the wealthy merchant or extensive land-holder. The merchant who trusts his frail bark to the guidance of the honest and industrious mariner indemnifies all his own losses by insurance. He feels not the loss of property by sea, but looks to his policy to meet all disasters; he feels not the distress of the hardy and honest sailor. If his vessel is captured or seized by foreign powers, or fire destroys his landed cargoes, he has a remedy by an appeal to Congress to indemnify his losses and remit his duties. Not so with the mariner; with the loss of the vessel his small and hard-earned income ceases, or he is discharged in a foreign country upon a stipend of twenty cents per day, and that often denied by the Government agents abroad. If he is lost with the vessel, his widow and orphans tell a tale of woe, which is seldom heard beyond a prison or almhouse. Much can be done to alleviate the distressed seamen by having life-boats stationed at places herein designated: the Wolf Trap light-boat, Willoughby's Spit light-boat, light-boat on Five-fathom bank, Cape Henry breakwater, Cape Henlopen, Fire Island inlet, and on board the boat off Sandy Hook. And by having the lights on our coast well arranged, and conducted under a proper system, the mariner hails with joy the beacon that directs him to his home and friends; he looks to it as his "pillar of fire by night" and "cloud by day" to direct him into a safe haven; he feels that he is safe when he makes a well-known light. But how frequently do we hear of shipwrecks, loss of lives, and great distress on our coast, during the inclement season of winter—many, no doubt, in my mind, caused from mistakes of lights, and sometimes by having them extinguished for some trifling repairs. This evil should be altered by an act of Congress; and no light should be extinguished for any repairs without at least six-months' notice in every important commercial paper throughout the Union; and, also, the Government commercial agents abroad should be directed to disseminate such information within their agencies.

Having in the foregoing report exhibited my views, and given my observations upon what I conceive to be an advantageous modification
of the present system for managing the light-houses, light-boats, &c., it only remains for me to report the actual condition of the same, grounded on personal inspection, as fully and accurately as could be done within the time limited.

* * * * * * * * *

I have the honor to be, very respectfully, your obedient servant,

WILLIAM D. PORTER,
Lieutenant, United States Navy.

Hon. LEVI WOODBURY,
Secretary of the Treasury, Washington.

* * * * * * * * *

FLORIDA.

A light-house at Carnival.—This is an important point. Because of the shoals opposite, vessels are required to keep close in with the cape. This light would also allow coasting vessels drawing ten feet water, bound south, to use an inside passage; thereby shortening the distance, and avoiding the Gulf stream.

No. 185. Cape Florida.—This house ought to be rebuilt on its present site; it is important for vessels bound inside of the shoals.

Three lights between Carysford Reef and Key West.—The distance is about 140 miles, and is the most dangerous part of the coast; vessels bound south, to avoid the Gulf stream, keep close in with the reef. The importance of these lights cannot be better shown than by the fact that about twenty wreckers, averaging thirty to forty tons, and manned by ten to twelve hands each, are well supported.

ON THE THIRD HEAD.

Light-house on Body's island.—The distance between Cape Henry and Cape Hatteras makes a light at this point of importance. Many vessels have been wrecked on this part of the coast. To distinguish it from the above two lights, it ought to have a revolving light, and be sixty feet in height.

The undersigned would recommend that the keepers of light-houses, and captains of light-boats, be prohibited from having other employment, particularly that of frolicking; that some other mode be adopted for supplying them with provisions, &c., for that was the general excuse for absence from their posts. We would further recommend that, in the stationary lights, the circle in which the lamps hang be increased at least one-third in diameter.

In conclusion, the undersigned remarks, that the very limited time he has had to make the survey has prevented him from making the full ex-
amination required by his orders, such as to report on the exact position of the light-houses and light-boats recommended, and their cost. Such a report could not have been made in less than eight months.

I have the honor to be, very respectfully, sir, your obedient servant,

G. N. HOLLINS,
Lieutenant, United States Navy.

Hon. LEVI WOODBURY,
Secretary of the Treasury.

REPORT OF CAPTAIN L. ROUSSEAU.

NEW ORLEANS, October 29, 1838.

SIR: In obedience to your instructions of August last, I have examined all the light-houses, light-boats, beacon-lights, and buoys, between the Sabine river and Key West, except the light-houses at Point-au-Fer, which I did not visit, on account of the difficulty and risk of approaching it with a vessel of the draught of water of the cutter Woodbury, the shoals extending some fifteen miles from the land, and having no correct chart of the place, nor pilot that could be procured. I have had opportunity to visit this light-house several times, through the inland passage, and can state its situation to be good; but I cannot report on its actual condition, which I presume has been made known to the Department by the collector of Franklin, Louisiana. Should, however, the Department believe it necessary that I should proceed to the place, I shall do so immediately on the receipt of your instructions to that effect.

I beg leave to report, that the light-houses at the mouth of the Mississippi will be quite sufficient, when the one at the southwest pass is built.

The light-house at the northeast pass and that at the south point are both in good order.

The light-house at Mobile point is in excellent order. The one on Sand island has just been completed, and is all that is necessary for the entrance of the Mobile bay.

A light-house on Dauphin island is, in my opinion, perfectly useless; and that opinion is corroborated by Captains Foster and Randolph, of the revenue service, who have been stationed in that district for a long time.

A light-house on Cedar point, and buoys between Cedar point and Lake Borgne, will be necessary, when the railroad between that place and Mobile is completed; but until then, I am of opinion it should not be built, as the site could not be well selected before.

Pensacola, being our only naval station in the Gulf of Mexico, ought to be so lighted as to enable our cruisers to leave or enter the port at any time of night; this might easily be done, by removing the present light-house to, the height between the old Fort Barrancas and the Oaks; by placing a light-house on the west angle of Fort Pickens; and placing
a small light-boat on the southwest spit of the Middle ground. The cost of those works would be, from the best information I could obtain, as follows: For removing the old light-house to the site proposed, eight thousand dollars; for the light-house on the west angle of Fort Pickens, seven thousand dollars; for the light-boat on the southwest spit of the Middle ground, twelve thousand dollars.

The site selected for the light-house at the entrance of St. Joseph is the most appropriate one for that purpose, and is all that may be necessary for that harbor.

A light-house at Cape St. Blas, is, I believe, a useless expenditure; and it is also the opinion of men well acquainted with the navigation of that part of the coast of Florida, such as Captains Foster and Randolph, and Lieutenant Commandant Coss, of the revenue service.

The light-house on the west pass of Apalachicola is well situated, but requires the following repairs, to wit: To protect the foundations, six hundred dollars; repairs of the keeper’s house, six hundred dollars; for new patent reflectors and twenty-three new lamps, instead of fifteen old ones, and English plate-glass for the lanterns: of these last items I cannot report on the probable cost, having no information on the subject. I beg leave to state that all estimates of cost have been made from the best information I could obtain. The site for the light-house on Dog island, for its east entrance of Apalachicola, is a good one.

The light-house at the entrance of St. Mark’s harbor is in a most wretched condition, and ought to be rebuilt immediately. I would recommend the same improvements in its lantern as those proposed for that of the west pass of Apalachicola. The keeper’s house requires extensive repairs, the cistern to be rebuilt, and a breakwater is necessary to protect the bank from being washed away. The cost of the above works will be about eight thousand dollars for the light-house; fifteen hundred dollars for the breakwater; and six hundred dollars for repairs to the keeper’s house.

A light-house is required on Egmont key, at the entrance of Tampa bay. I would recommend one being placed on the north point of the key—say about thirty feet to the southward of the beacon now existing. The probable cost of a light-house sixty-feet in height, ten thousand dollars.

The light-boat Key West, at the bar of the northwest channel, is well placed, and very useful. When the improvements recommended by the collector of Key West, in his letter of the 9th instant, and herewith annexed, are completed, nothing more will be required for the protection of navigation.

After a careful examination of the Tortugas, I can see no advantage to be derived from placing a light at East key, and one at Loggerhead key in lieu of the present one on Bush key; which latter I believe to be the most suitable site for a light-house. I would recommend that the height of the present light-house be increased thirty feet.

I would also recommend that, in building light-houses, whether by contract or otherwise, it should be done under the immediate superintendence of an officer of the engineer corps.

The present mode of superintending and managing the light-houses,
light-boats, &c., does not appear to me to require any modification, although I would suggest the propriety of allowing an assistant to all keepers of light-houses in this district; the light-houses being generally distant from any inhabited places, in case of sickness, to which they are most exposed, the keepers may be left destitute, if alone.

I would further recommend that no oil for the light-houses in this district should be shipped before having been carefully inspected by competent persons, and ascertained to be of a good quality.

Respectfully, your obedient servant,

L. ROUSSEAU, Captain.

S. PLEASONTON, Esq.,
Fifth Auditor, Washington City.

REPORT OF LIEUTENANT JAMES T. HOMANS.

DETROIT, November 5, 1838.

SIR: In obedience to instructions received, I proceeded, in August last, to survey and examine the northern lake boundary, west of Detroit, under the provisions of the act of Congress, approved 7th July last, respecting light-houses. Leaving Detroit on the 20th of that month in the vessel chartered for my use by the collector of that port, I followed the boundary designated through Detroit river, lake and river St. Clair, Lake Huron, Saginaw bay, Straits of Michilimackinac, east and west side of Lake Michigan, to Green bay; from that place to St. Mary's river, entering it by Detour passage, most used by vessels; to Sault Ste. Marie, near foot of Lake Superior; thence to this place, via Mackinaw; embracing in the route a distance, by estimate, of 1,825 miles. I will first state the condition of the light-houses in operation in my district, all which I visited except that on Pottawatamie island; it could not be approached at the time of my being in the vicinity, owing to the stormy weather, and consequent heavy surf upon the shores of the island.

The light on Otter Creek point, at the foot of Lake St. Clair, though a new building, was considerably leaky in the platform at the top, on which the base of the lantern rests; also, in several parts of the main wall of the building, from the plastering mortar on the outside having come off. The repairs so necessary for this building have since received the attention of the collector of Detroit, in whose district it is situated. In other respects the condition of this light was satisfactory.

The light near Fort Gratiot, at foot of Lake Huron, I found in cleanly and orderly appearance; the keeper, Mr. McDougall, has often, during his thirteen years' attendance upon it, received strong encomiums of praise from masters of vessels navigating the upper lakes. Several of the panes of glass in the lantern of this light were broken, alleged by the keeper to have been done by the gulls or other wild fowl that abound in this neighborhood. No extra glass being on hand, the damage could not very readily be repaired; and no suitable glass was to be had, without great delay in sending for it. I would here remark, that I found nearly all the light-houses in my district also without any extra glass to
replace any broken; thus, if any breakage of extent occurs in the lanterns, considerable time must necessarily elapse before they can be put in desirable condition again.

The light on Thunder Bay island, Lake Huron, was next in my route. The buildings there are in a critical situation, and may, if not soon protected by some barrier, share the fate of one formerly near this site, and that on Bois Blanc island, which were undermined and destroyed by the action of gales on the lake. This house requires considerable repairs, being open to the weather in some parts during storms; on the western side especially, from the same cause as that at Otter Creek point—the falling off of the outside plastering. It was, in other respects than those cited, in good order. The base of this light-house is now nearly washed by the waters of the lake; should their present high state continue, it cannot stand long. The best means of preservation occurring to me would be, to build cribs of large timber, and fill them with stone, in such positions as to form a wall on the shore of the lake; thus, a protection to the light-house. The rocky formation of the shore would prevent the driving of piles for building a pier, that would, if practicable, cost less than the cribs; the latter, for this purpose, would probably not exceed an expense of $800. Immediately in the rear of the present light-house buildings at this place is ground of considerably more elevation, where they would be safe; and it would, perhaps, be more economical in the end to demolish and rebuild them there.

From Thunder Bay island I went to Bois Blanc island, and made choice of a good location for the new light-house buildings authorized to be erected there; which selection was concurred in by the collector of the district, Mr. Wendell. It is some rods farther from the lake than the former site, and on much higher ground. Mr. Wendell had issued notice for proposals for construction of the buildings before the close of this season's navigation, and received, during my stay at Mackinaw, such as were satisfactory to him, within the limits of the appropriation.

The light at St. Joseph, on the east side of Lake Michigan, next received my attention. I found it in excellent order in all respects; the building in good repair; and lantern well cleaned, some of the reflectors of which, from long use, were not of so good service as desirable. Much inconvenience arises from the long intervals in visits of the contractors. The keeper at St. Joseph informed me that for the two years preceding this summer he had not been visited by them, they alleging that the scanty emoluments of the contracts would not allow more frequent calls.

Michigan City light, only in operation this summer, was in good order, and apparently, as well as by common report, carefully attended.

Of the light at Chicago, the same may be said as to attendance; though quite an old building, and requiring considerable repairs. The keeper here, as those at some other lights, expressed doubts as to the stock of oil on hand holding out until the usual time of receiving supplies next season.

In my visit to Saginaw, I ascertained that no preparations had been made for erecting light-house buildings at the mouth of that river, as authorized. The commerce of this place is considerable, and increasing; the lumber trade alone will soon be of important value, and well worthy
of this guide to its location. Saginaw city is twenty miles up the river of the same name; the citizens of which town look forward to great increase in their prosperity when the canal, now being made, is completed, connecting the waters of Saginaw river with those of Grand river, on Lake Michigan; by which internal navigation a lengthy voyage on the lakes is obviated.

The navigation of Saginaw bay, from its great extent, is oftentimes as boisterous as that of the adjoining lake; and on its surface, the considerable commerce using it requires some additional aid from Government to make the traverse secure. With a light-house on the north-eastern part of the outermost of the Charity islands in that bay, which may be seen soon after leaving that on Point-aux-Barques, and form a connecting link with the one at the mouth of Saginaw river, the bay navigators will feel themselves more secure. It would also serve as a guide to Torwass harbor, on the western shore of the bay, bearing about N. NW. from the outer point of the island referred to. It is a safe shelter from all winds and the worst of storms.

On arrival at Mackinaw, I found there the light-ship belonging to the Straits of Michilimackinac undergoing extensive repairs, having been driven from her appropriate moorings during a heavy gale of wind last year, and thrown upon the beach. The difficulty of obtaining both mechanics and materials for repairs at Mackinaw is great, having always to send to Detroit, and sometimes farther, for them; which accounts, in some measure, for the great delay in completing her repairs. I am, nevertheless, of opinion, that with due care and attention she could have been much sooner replaced in her station, which she did not reach until the 20th of September, having been the whole season, until that period, in the harbor of Mackinaw. I have, since last leaving there, learned she was again driven from her place by stress of weather. By the frequency of these removals, and upon examination of the vessel, I am satisfied she is very unfit for that location; and as she can be usefully employed near the flats of Lake St Clair, where the shelter is good, I would strongly recommend that another one be immediately built, upon a more approved model, for the straits, so as to be ready for removal there on the opening of navigation in the spring. The dangers to the large commerce passing through these straits are great, from the extensive shoals, (that of Wagooshance in particular,) and demand the safeguard of a light-vessel that may be relied on at the point most desirable.

By a statement of the collector at Mackinaw, hereto attached, it appears that nearly 57,000 tons of shipping entered there between the 14th of April and 25th of September last. I refer to it, to exhibit the importance of having the dangers to the navigation of the straits referred to, through which all this commerce passed, mitigated, so far as possible, by Government establishing beacons that will serve as guides both by day and night.

The light-house on Wagooshance shoal is the most urgently required point for a light, and for which, happily, an appropriation has been made; yet it will take two years, by moderate calculation, to complete the erection of it, there being eight feet of water on the shoal. Lieutenant Pendergrast made, in 1837, a thorough examination and report upon all
matters connected with this light, now on file in the Department; to which reference is respectfully made, as containing information, not in my power to obtain at a more stormy season of the year, when I visited this point.

The value of the immense amount of shipping stopping annually at Mackinaw for supplies, or for shelter in storms, calls upon the Government for some assistance to preserve its harbor by small piers projecting from the points forming it, which are rapidly wearing away by action of the waters of the straits. A pier from each point, of 150 feet length, would not only secure them from farther injury, but add greatly to the safety of the harbor itself, and comfort of the hundreds of persons sometimes collected there, on board steamboats and other vessels, in stormy weather. The light on Pottawatomie island, near the entrance to Green bay, the last in my route of those in operation, I was unable to examine, either in passing in or out of the bay, for reasons before stated. The island is high, and only accessible on one side, which was exposed to the gales prevailing while I was there. I satisfied myself, as well as I could, by inquiry of masters of vessels and others, that this light was in good order, and carefully attended.

The next subject to which my notice is directed—the selection of sites for new light-houses authorized—I used my best exertions to have satisfactorily executed. I chose the most westerly of the two points, known to lake navigators as Point-aux-Barques, near the entrance to Saginaw bay, for the light there, because it is sooner seen by vessels approaching from the northward and westward, by which it will be most used; also, as being near a shoal, dangerous to the navigation of its vicinity. There is stone in considerable quantity near this location, which can be used in constructing the buildings. The land, I presume, belongs to Government, or can be had for a moderate price, there being no settlements within several miles, and the soil very barren. On South Manitou island I made choice of a site for the light-house authorized to be erected there, on the southeastern point of land forming the harbor, upon a high knoll, on which a stake was appropriately marked; the bearing of it, per compass, from the house near the steamboat landing, S. by E. There can be little dispute as to this point being the best for the light-house, it being open to the course of vessels going up or down the lake, and abundant depth of water within a few yards of the point for the largest craft. The knoll referred to is about thirty feet above the level of the lake; but, being formed of sand on the surface, will have to be well excavated to make a safe foundation for the light-house buildings. The other point of land forming this harbor is very low, and unfit for erection of any buildings on it; it is also shut in from sight of the usual track of vessels. As all the steamboats sailing on the upper lakes visit this place for supply of fuel, or for shelter in storms, (for the latter purpose used by all other vessels,) thus continually in use by some of the shipping, the need is urgent for the early construction of the light-house here. I saw within it, during one twenty-four hours of my stay there, a number of vessels, the aggregate of whose tonnage was 2,000 tons. The value of this harbor is the more enhanced by its being the only one admitting the largest vessels in all weather, in the direct route
between the Straits of Michilimackinac and Chicago—a distance of 300 miles. Presque isle, on Lake Huron, may have the same said of its important usefulness as South Manitou. It is likewise a larger harbor, well sheltered from the winds, and is frequented by all classes of vessels passing Lake Huron, as South Manitou, on Lake Michigan, is for shelter in storms, and for supply of wood for steamers. It is, too, the only safe haven on the route between Fort Gratiot and the Straits of Michilimackinac, a distance of 240 miles. On upward voyages, vessels failing to reach the safe precincts of Presque isle are often driven by stress of weather back to Gratiot, 180 miles—no good shelter intervening. The site selected at this place for a light-house is upon the point of land on the northeast side of the entrance, where the ground is moderately high; it is indicated by a suitable stake, and marks on the trees near. From this situation, the light can be best seen by vessels passing up or down the lake, and will serve as a guide to those seeking entrance into the harbor.

At New Buffalo, (another point for which an appropriation for a light-house has been made,) I deemed the most suitable site for one to be on the high bank south of the entrance to the river; the spot is well marked by letters on the trees, and a proper stake in the ground. The elevation of this site is about forty feet from the lake, and conveniently open to vessels from any direction on it. A building of twenty feet in height would be amply sufficient to enable it to be seen as far as any other in that region. The land upon which this location rests is the property of Captain Nessel Whitaker, an old resident, and one of the first settlers of New Buffalo. Sufficient for the light-house buildings and keeper’s use may be had at moderate cost—say one hundred dollars per acre. The other point at the entrance of the river is low, and its shape frequently changed by the action of the waters of the river and lake; it would, therefore, be imprudent to place any buildings upon it.

The light-house authorized to be put on Grassy island, near the head of Green bay, is the only one named in my instructions not yet referred to. This island was carefully examined during my stay there, and decided to be unsuitable for construction of buildings upon it of any durability, and totally uninhabitable by a keeper, being nearly under water, from the great rise of the lake, since the recommendation for a light upon it was made. I therefore respectfully advise that the necessary buildings appropriated for be put upon Tail point, (so called,) a short distance below Grassy island, where the land is much higher, and the situation deemed by every shipmaster and old resident of the place, that I conversed with, preferable to that of Grassy island, for usefulness to vessels visiting that part of Green bay.

Having concluded the record of sites selected, and reasons governing the choices made, I will now proceed to report my opinion upon the expediency of erecting light-houses, at the points named within my district, in the 4th section of the act of 7th July last, viz: Clinton river, Mackinaw, Muskegon river, North and South Black rivers, Calumet river, Southport, Kewaunee, Sauk, and St. Mary’s rivers. I am bound by my sense of duty to report upon these points, as to their condition in reference to commerce when I visited them, not as to what they may have
been, or are expected to be. Where there are not harbors capable of admitting vessels navigating their vicinity, I cannot see the necessity or expediency of building light-houses. Clinton river, on Lake St. Clair, the one first named, is not adjacent to the usual route of vessels passing through this to the upper lakes; its case must, therefore, rest upon its own merits. Thus, a light-house there could be of no use to any but the commerce trading to it; and that, being limited to a very few vessels during the year, might not justify the expense of placing a light there. There is a difficulty, too, arising from the marshy nature of the banks of this stream, near its mouth, that will not permit the erection of any suitable buildings on them; a floating light is, therefore, the only one practicable of being established there. Six feet was the depth of water on the bar of this river, when I examined it, and at a time when the waters of the lake were very high; it would, therefore, only admit the smallest class of vessels. When the State canal, uniting the waters of Clinton river with others in the interior of the State, is finished, new sources and inducements to trade will be opened; the increase of which trade may make requisite a light-house and other Government works at its mouth.

A beacon-light, near the town of Mackinaw, has my strongest recommendation; the large amount of commerce passing through the straits near there, calls for the protection and safeguard such a light would render. The narrowest part of the straits is opposite this point; of course increases the dangers to the navigation just there, especially in the night. My own experience, in many voyages through them, has acquainted me with the difficulty of finding this narrow pass, or entering the harbor of Mackinaw, in the dark, without some such guide as a beacon, properly located, would afford. The western point of this harbor I deem the best site, because the land is considerably higher than on the eastern side, and commands a better range for vessels approaching from either east or west. The light on Wagooshance shoal might be seen before losing sight of this, and vice versa; thus rendering comparatively safe the night traverse of the strait alluded to. A suitable lot of ground can be had on the point named, of Mr. Dousman, one of the oldest residents of the town of Mackinaw: the title I examined, and believe to be unquestionable. An estimate for a beacon-light on this spot accompanies those made for other points recommended by me.

Muskegon river, on Lake Michigan, came next under my observation. It is a large stream, opening, within a half mile of its outlet, into a considerable lake, eight miles long by four wide. The channel in, is wide and easy of access, and not less than twelve feet of water in it; making this harbor, in my estimation, the best on Lake Michigan, all things considered. Its value as a safe haven, and the rich lumber trade in which it will soon be engaged, (three extensive steam saw-mills have been erected there,) entitle it to a light-house near the entrance. I selected a point, on the south side of the river’s mouth, as the best location, in the event of an appropriation being made for a light there. The land at Muskegon yet belongs to Government, it not having been placed in market; and should it be, a reservation of some would be advisable for light-house purposes. From Muskegon river I advanced south, and examined North
Black river, which I also found to be a large stream opening into a lake, navigable its entire length, six miles, by large vessels; and having in the river, three miles above the lake just described, seven feet of water. Pine, hemlock, and oak timber abound here; and the enterprise of the settlers has raised large steam saw-mills to prepare it for market. A vast trade in this lumber would be carried on from this place, but for the fluctuations in the depth of water at the outlet of the river, which is affected by every westerly gale, throwing up such large quantities of loose sand and gravel as to bar both ingress and egress of vessels. I was credibly informed that there was not less than eight feet of water there in the spring, which was reduced at the time of my visit, by the cause just stated, to two feet; and at times an entire barricade is formed by it. An evidence of the fact of there having been a good depth of water recently on the bar of North Black river, is a fine schooner built by the inhabitants of the settlement some miles up the lake, whose surprise was great on bringing their vessel down this summer to the outlet, richly freighted with lumber, to find the mouth of it closed in the manner described. I earnestly hope that the fact here stated (which will apply, also, to South Bla-k river, Pigeon River lake, and other fine harbors on the east side of Lake Michigan) may induce from Congress some appropriation for opening the entrances to them. Rivers au Bétaux, Manistee, Pere Marquette, White, and Pentwater, are, as well as those just mentioned, capable of being made excellent and safe harbors, accessible to any vessel navigating the lakes. Two parallel piers to each, of moderate length, and of trivial cost compared to the utility, would soon make abundance of fine harbors on this shore, where they are so much needed. The strong currents of those rivers would soon deepen their channels sufficiently, and the piers maintain the depth. The winds in this region prevailing mostly from the westward, make this side of the lake more critical to mariners, from its being the lee shore so continually, and the necessity greater for good ports of entry.

Pigeon River lake I also looked into, and was gratified with the manifestations of genuine enterprise displayed by the company forming a settlement there; among the tokens of which, is a neat light-house near the entrance to the harbor, (named by them Port Sheldon,) kept regularly lighted throughout the season. It has been truly useful to lake navigators, more especially those destined to Grand river, thirteen miles north; there being no other light in operation on the two hundred and fifty miles of lake-coast north of St Joseph. South Black river is a fine navigable stream for many miles after passing its entrance, which we found in the same condition as North Black river; the condition of neither, thus, would justify a recommendation from me for a light-house at them.

Calumet river, twelve miles south of Chicago, was carefully sounded at its outlet, but showed only four feet water there, and that in a circuitous channel. I was in hopes to find this river more easy of access, the necessity being urgent of a safe harbor in that vicinity.

Southport had its harbor entirely closed at the period of my visit to it, and had been so sometime.
Sauk and Kewanee rivers had but little water at their mouths; which obliges me to class them, and the two previously mentioned, with the Black rivers, for the same reasons: as not calling for light-houses near them at present.

St. Mary river is the last on the list for examination. This river, (or, properly, strait,) connecting Lakes Huron and Superior, is navigable for vessels of the largest class in use on the lakes, as far up as the falls, and within a mile of the junction with Lake Superior. Steamboats of 600 tons burden have traversed the waters of this strait to Sault Ste. Marie. The gross amount of tonnage arriving at the Sault, in the year 1837, was 2,505 tons; and this year, prior to the 22d of September, 3,804 tons: showing a large increase from the previous season. One-fourth of this amount was from Lake Superior.

When the proposed ship canal (already commenced) shall be completed around the falls of St. Mary, a large trade will be opened with the fisheries, minerals, and other valuable productions of Lake Superior and its borders. The statement of the commerce annually afloat on this stream, will, I trust, justify me in recommending the erection of a light-house near its entrance into Lake Huron; the best site for which I judged to be on the left-hand point on entering, where the ground is favorable, and can be farthest seen by vessels on the lake.

My attention having been directed to all matters in reference to light-houses in my district, I examined the four points at which lights had been authorized: Grand river and Kalamazoo river on the east side, Racine and Milwaukee on the west side of Lake Michigan. They were contracted for some months before my visits to their locations, and to be finished by the 15th of October—so I was informed by one of the contractors. At Grand river, I regretted to see the materials so inferior in use for the buildings being put up there, and the work on a par with the materials; so much so as to induce a communication from me to the Fifth Auditor upon the matter. The walls of the keeper's house were in part erected, and composed mainly of round stone taken from the bed of some river, and the mortar of very poor consistency. No further progress was made than the excavating for the foundation of the light-houses; the intention was, according to the representation of some of the workmen, to build it of similar materials to that of the keeper's house. Neither of the contractors was present. Mr. Eastman, inspector of customs at Grand river, Mr. Badger, of Port Sheldon, and Captain McKenzie, master of the steamer Governor Marcy, coincide with me in the opinion given. At Kalamazoo, on the 5th of September, no other preparations, that we could discover, were made for the construction of the light-house there, than the collection of a pile of stones near the intended location. The buildings at Racine, near the mouth of Root river, so far as they were advanced, were composed of good materials, and put together in workmanlike manner: the best of hard brick were used, good lime for the mortar, &c.

Milwaukee light-house and tenement was the only one of the four, the appearance of which justified the belief of completion within the period agreed upon in the contract. These were likewise well put up, with good brick, thoroughly manufactured. The delay of completion
here was the non-arrival from the East of the large stone for platform, and the iron-work of the lantern.

Serious objections exist to the site upon which the Milwaukee light has been placed; it must have been chosen by some one little acquainted with navigation, or the wishes and interest of those connected with it, and has been apparently located to gratify some of the townspeople, at the termination of one of the streets, near the bank of the lake, where it forms an object of interest, from its neat appearance when viewed from other parts of the village. For purposes of practical utility to those engaged in the commercial business of the lakes, this site is about the worst that could have been taken, in the vicinity of the spot indicated in the law authorizing its construction. In this opinion I believe myself to be supported by all the masters of vessels trading to the neighborhood referred to. The site selected by Lieutenant Pendergrast is at the mouth of the river on which the town of Milwaukee stands; no deference was paid to his opinion in erecting the buildings spoken of, they being a mile off from the spot of his choice. The points of land at either extremity of Milwaukee bay, into which the river discharges, would appear to any seafaring person the second choice for the location of a light, which could thence be seen at a great distance by vessels approaching the bay.

In continuation of the objects in my district to which my instructions called attention, that of buoys is deserving some consideration and recommendatory remarks. The flats of Lake St Clair, over which all the commerce of the upper lakes must necessarily pass, have heretofore been annually staked out to show the greatest depth of water, by some public-spirited shipmaster, without compensation for his labor. These stakes are insufficient guides, because from their slowness they are liable to be destroyed by vessels passing over them, and otherwise casually removed. The length of the route, the narrow and crooked course of the channel, render the passage in the night impracticable to any but the smallest vessels; it requires good daylight, and sight of every stake in succession, for the safe navigation of this vicinity by the vessels of heavy tonnage. In upward voyages, the sight of the first stake is of great importance, as the remainder can usually be seen alternately from each other. At the first stake, I would therefore recommend the stationing a light-ship; the one now in the Straits of Michilimackinac would answer well, should it be replaced by another, as advised in a former section of this report. Suitable buoys, made at the expense of the Government, and placed to indicate the channel over these flats, could be kept in position by the keeper of the light, and taken up at the close of navigation, when the light-vessel would also be removed, and again replaced in the spring, on return of the light to its station. Another advantage of this site for a light at this first buoy, is, that it could be seen from a great distance, (by day and night,) and enable vessels reaching this desirable point after dark to anchor safely until daylight permitted sight of the way over the flats. At the head of Green bay, near the mouth of Fox river, and town of Navarino, the principal place of trade in the bay, there are likewise shallow flats of considerable extent, with
a circuitous channel over them, which should be properly buoyed out, and the care of the buoys given to the keeper of the light on Tail point, near which the flats commenced, which would answer, in reference to those flats, a purpose similar to that near St. Clair flats, viz.: vessels could steer safely for it in upward trips, after night, and anchor near until morning; daylight being also essential to safe navigation here.

The only points in my district not named for survey and examination, upon which I would report favorably for light-houses, are two: the most necessary of the two is the southern extremity of the island in Lake Michigan, known as the Big Beaver. It lies in the direct route of vessels passing from the Straits of Michilimackinac to Green bay, and other parts of the northwestern section of Lake Michigan. The loss of property from shipwrecks on the Beaver island has been considerable this season alone, and in value to exceed the cost of building many light-houses and maintaining them. The steamboat De Witt Clinton, in the month of September last, with a full and valuable cargo, struck in the night on a shoal near the Big Beaver, and was obliged to throw overboard nearly $20,000 worth of her lading, including the fixtures for the lantern of the light at Milwaukee, before she could be got off. The disaster to this vessel is ample testimony of the necessity of a light for that point. Though many other losses, and some total wrecks, could be cited in addition, that one is selected because of so recent occurrence. The other desirable situation for a light is upon the northeastern end of the outermost of the Charity islands, in Saginaw bay, to which I have heretofore particularly referred, in this report. In referring again to the condition of the light-houses in operation within my district, I would recommend that each be supplied with extra glass, and duplicates of all the equipments of the lanterns essential to having them in perfect condition for use; and thus be prepared for contingencies. I have before stated, in detail, that all under my inspection, so far as the keepers were concerned, were apparently carefully attended to; no complaints whatever to the contrary reached me during my tour. Being required by a clause of the third section of the act of Congress under which my surveys were made, also further to report whether, in my opinion, the public interest requires any modification of the system of erecting, superintending, and managing light-houses, I now proceed to give my views in reference thereto, with synopsis of the plan most likely, in my opinion, to subserve the public welfare. All light-houses heretofore built have, I understand, been contracted for, and superintended in erection, by the collectors of customs in their respective districts, who have also had charge of, and supervision over, all matters connected with them, after being in operation. Some supervisionary authority appears pertinent to their other official duties, which are so entirely connected with the commercial trade of the country; yet the latter may be imagined to require such constant personal attention as to interfere with their proper examinations, or frequent inspection of the light-houses in operation, or those being constructed in their provinces, when of any considerable extent. The only deviation I have known from the practice heretofore in vogue, of collectors superintending contracts for building light-houses, was in the case of those
ordered at Grand river, Kalamazoo river, Racine, and Milwaukee, to the superintendency of which a special agent was appointed. Whether any benefit has arisen by the experiment, the Department has the means to ascertain. My proposed plan is to have a revenue vessel of 150 or 200 tons burden (a steamer preferred) provided for the district examined by me, the commander of which is to be appointed overseer and inspector of all matters appertaining to light-houses, with instructions for his government, emanating from the Treasury Department and the several collectors within whose jurisdiction he may have occasion to act. I believe it would be highly beneficial to have every light inspected at least twice during the season of navigation, and an annual report thereof made. The appointment of a general inspector in each district being publicly known, would enable masters of vessels navigating its precincts to know where and to whom to report any neglect of keepers of the lights, in regard to which matter, on the upper lake especially, they are now somewhat at a loss.

The adoption of some such plan would save the Department some of the inconvenience arising from the present condition of the light-house system, and remedy some of the evils of it, and otherwise be of advantage and public utility. I would also have the contractors for the supplies reside nearer the sphere of their duties than some now do. In connection with this arrangement, I would respectfully recommend the appointment of a custom-house establishment at the port of Chicago, on Lake Michigan, where is probably concentrated three-fourths of the trade of the upper lakes. No representative whatever of our Government, in that department, being now stationed there, the frauds upon, and the violations of the revenue laws of our country, on the upper lakes, are innumerable, and, without the presence of any authority competent to check them, are on the increase. Upon the entire lake boundary explored by me, west of Detroit, I met with no custom-house officers, except at Mackinaw, Grand river, and St. Joseph. I saw many vessels without license or enrolment, and one British vessel, that had no doubt distributed all her cargo along the shores of Lake Michigan; in one of the byports of which I saw her, with a swept hold.

There was nothing to interfere with this, or any other vessel of the same country, making frequent contraband voyages between Canada and convenient points on our shore. I should presume the commerce of Chicago to be of sufficient importance to authorize its being made a separate custom-house district and port of entry. This being done, and a good revenue vessel, capable of withstanding the storms of the upper lakes, cruising on them, enforcing the revenue laws, inspecting light-houses, and performing other duties appertaining to such vessels, I am of opinion that the public welfare would be benefited beyond the value of the expenditure required.

With other papers, I have the honor to transmit a copy of a notice I caused to be published in some of the newspapers on the lake prior to my setting out on my tour, inviting information from masters of vessels and others interested in the objects of the service I was about to proceed upon. Also, a letter to me from Mr. E. H. Macy, of North Black
river, containing information corroborating some of my statements concerning that place.

I have the honor to be, very respectfully, your obedient servant,

JAMES T. HOMANS,
Lieutenant, U. S. Navy.

Hon. LEVI WOODBURY,
Secretary of the Treasury.

REPORT FROM MAJOR H. BACHE ON BRANDYWINE LIGHT-HOUSE—1839.

OFFICE OF THE BRANDYWINE LIGHT-HOUSE,
Philadelphia, November 1, 1839.

SIR: The following report of the Brandywine light-house for the past season, made in compliance with the general regulations of the bureau, is respectfully submitted:

The operations have, in consequence of the failure of Congress to make the additional appropriation called for last session, been limited to such expenditures as could be covered by the balances from former years, and, from the insufficiency of these, were confined to measures preliminary to taking position at the site of the work. Among the most important of these is the building of the caisson, by means of which it is proposed to establish the foundation, and the preparation of the foundation stone. The caisson, with unimportant exceptions, was completed some months since. It is elliptical in form, about fifty feet in length by forty feet in width, and twenty-five feet high, constructed entirely of white oak, thoroughly iron-fastened, and in all respects a substantial vessel, capable, it is believed, of resisting the shock to which it will be exposed, and fully equal in other respects to fulfil the objects for which it was designed. It is still on the stocks, where, protected by a roof from the weather, it will remain until required for use. The drawing, with the explanatory notes annexed hereto, will show the details of construction. The stone for the foundation, or the foundation rock as it may very properly be called, is now preparing under the contract of the 9th of January last. Two courses are finished, and two more are in a state of considerable forwardness, and will, with the remaining courses, be ready before the opening of the coming season of operations. The foundation rock is 42½ feet long by 31½ feet broad, and 20 feet high. It is formed of 671 blocks of rough-hammered stone, disposed in ten courses. Of these blocks 372 weigh, each, three tons, and are regular and alike in form; and 299 weigh, each, from one to three tons, and are irregular and unlike. A single course weighs 161.33 tons, and the entire foundation rock 1,613.3 tons. Each course, as finished, is laid dry at the quarries, where the necessary platforms and cranes are provided, to prevent delays in building, arising from errors in working the stone, which might prove fatal to the success of the work. The brick-pavement bond is the one adopted for the foundation rock; the joints of each course lying at angles of 45 degrees, with those of the courses adjacent, in order to resist, in the most effectual manner, the disposition
which the mass, from unequal subsidence or other cause, might have to fall or break off. To give still greater security against this tendency, copper dowels and cramps will be used to bind the whole together. Of the latter nearly 1,700 will be employed.

The original design for this work contemplated a foundation, built on a mole of breakwater stone from the level of low water. The objections to this mode of construction were stated in a communication addressed to the bureau on the 14th of July, 1837, in which, for reasons then given, it was recommended to establish the foundation by means of a caisson. Further reflection has served to confirm these views. Fears were entertained that, by the plan first proposed, the superstructure, being built upon breakwater stone thrown at random on the bottom, would by unequal settling be liable to fracture; and it was doubted whether heavy masses of masonry, raised upon such a base, ever proved entirely satisfactory. It was also urged, that as the masonry, until it reached high water, would necessarily have to be carried on at short intervals of time, and under very great disadvantages at so exposed a position, the cost of construction would thereby be very much increased. These objections are obviated by the use of the caisson, as the work may be carried on at any stage of the tide, and the masonry built from the bottom, saving the thickness of the caisson, which it is presumed will settle in the sand; thus affording a reasonable expectation that the subsidence will be equal, and the superstructure secured from liability to fracture. It will be remarked that the employment of the caisson does not necessarily constitute a modification of the first design, but rather furnishes a means by which that design may be securely carried out. It would fail, however, to yield all the advantages which belong to such a mode of construction were the foundation not to receive, under the facilities afforded, a more perfect and stable character. It has therefore been deemed proper to substitute for this part of the work masonry of wrought stone, instead of the rubble masonry resting on breakwater stone, as was proposed in the first instance. These changes involve, upon the whole, a considerable increase in the cost of the work, an increase, however, which is fully justified by the additional security afforded, of prosecuting the operations to a successful termination, and by the greater stability that will be given to the work itself. This increase, as well as that arising from advance in prices since the date of the first estimate, will be indicated under the proper heads. The most prominent among the latter is in the cost of breakwater stone, advanced 20 and 11 per cent. respectively for the two sizes, and which is now set down at the contract price of the present season for the Delaware breakwater. It will also be seen that the contingencies have been raised to 17 per cent., as that has been the average, nearly, for several years at the above work, and there is no reason to suppose they would be less for the Brandywine light-house.

The following statements will show the increase which the proposed modifications and the advance in prices will cause in the cost of the work:
The original estimate for the space which will now be occupied by the foundation, established by means of a caisson, was as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 tons of breakwater stone, of pieces of two tons and upward, at $2 50 per ton</td>
<td>$102 50</td>
</tr>
<tr>
<td>1,436 tons of breakwater stone, of pieces of $\frac{1}{4}$ to 2 tons, at $1 80 per ton</td>
<td>2,584 80</td>
</tr>
<tr>
<td>340 cubic yards of heavy building stone, at $5 20 per cubic yard</td>
<td>1,768 00</td>
</tr>
<tr>
<td>Laying the same, including all expenses, at $8 20 per cubic yard</td>
<td>5,848 00</td>
</tr>
<tr>
<td>Contingencies, 15 per cent</td>
<td>10,303 30</td>
</tr>
<tr>
<td>Total amount by original estimate</td>
<td>11,848 80</td>
</tr>
</tbody>
</table>

The revised estimate, by the modified plan, for establishing the foundation by means of a caisson, and under the advance in prices, is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caisson</td>
<td>$11,011 63</td>
</tr>
<tr>
<td>962 cubic yards of rough-hammered stone, including lewis holes and cramp holes and channels, at $22 95 per cubic yard</td>
<td>22,077 90</td>
</tr>
<tr>
<td>Laying the same, including all expenses, at $8 60 per cubic yard</td>
<td>8,273 20</td>
</tr>
<tr>
<td>2,092 copper cramps, at $1 25 each</td>
<td>2,615 00</td>
</tr>
<tr>
<td>Contingencies, 17 per cent</td>
<td>48,977 73</td>
</tr>
<tr>
<td>Total amount of revised estimate by modified plan, &amp;c.</td>
<td>51,453 94</td>
</tr>
<tr>
<td>Total amount of original estimate</td>
<td>11,848 80</td>
</tr>
<tr>
<td>Total amount of increase</td>
<td>39,605 14</td>
</tr>
</tbody>
</table>

How much of this increase is fairly attributable to the new plan, and how much to the advance in prices and increase for contingencies, it is not easy to determine. If, however, the average prices now paid for breakwater stone be taken as a criterion, more than $8,000 is probably assignable to the latter causes.

The exposed situation of the Brandywine shoal, lying as it does in the widest part of the bay, and within eight miles of the ocean, renders it absolutely necessary that the protecting work be formed at once on bringing the caisson in position; as, on the one hand, were the foundation constructed and no protection provided, the action of the waves, in their recoil from the mass, by washing away the sand composing the shoal, would in a very short time undermine and destroy the work; so on the other, were the protecting work completed in the first instance,
deposits of unequal density and irregular form would be induced, where
now the bottom is singularly hard and flat. The removal of these de-
posits, and of any stone which from carelessness or design may have
been thrown within the same space, would be attended with much labor
and no inconsiderable expense, and, what is of much more importance
in a work of this character, with a delay which might prove fatal to the
undertaking. The two operations, indeed, should be carried on as nearly
simultaneously as their very different characters will permit, and, to be
secure against the ice and storms of the succeeding winter, be brought
to a close in a single season. At so exposed a position as the Brandy-
wine, this may be set down at barely three months, commencing with
the 20th of May, a period certainly very limited to complete a work of
the extent contemplated, considering the difficulties and vexations under
which it must be prosecuted.

The following estimate for the next season is based upon the views just
given. Admitting their soundness, the necessity of providing at once
ample means to carry them out, need not be urged. The appropriation
of a less amount would merely take from the Treasury a sum that could
not be applied profitably to this work. It is also proper that the appro-
priation be available at least two months before the opening of the sea-
on, to afford time for making the necessary contracts and arrangements;
otherwise, all operations must be postponed until the following year.

*Breakwater, which will form a part of the protecting mole.*

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>11,711 tons of breakwater stone, of pieces of 2 tons and upward, at $3 per ton</td>
<td>$35,133 00</td>
<td></td>
</tr>
<tr>
<td>21,438 tons of breakwater stone, of pieces of (\frac{1}{2}) to 2 tons, at $2 per ton</td>
<td>42,876 00</td>
<td></td>
</tr>
<tr>
<td><strong>Cost of breakwater</strong></td>
<td><strong>$78,009 00</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Foundation to floor of cellar.*

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>775.24 cubic yards of rough hammerd stone, including lewis holes and cramp holes and channels, at $22 95 per cubic yard</td>
<td>17,791 75</td>
<td></td>
</tr>
<tr>
<td>Laying the same, including all expenses, at $8 60 per cubic yard</td>
<td>6,667 06</td>
<td></td>
</tr>
<tr>
<td>1,686 copper cramps at $1 25 each</td>
<td>2,107 50</td>
<td></td>
</tr>
<tr>
<td><strong>Cost of foundation to floor of cellar</strong></td>
<td><strong>37,577 94</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Contingencies, 17 per cent.** 19,649 78

**Total amount.** 135,236 72

**Amount already appropriated.** 45,000 00

**Additional appropriation required for next season.** 90,236 72
It is proposed to carry on the operations under the foregoing estimate, in the following manner:

The proper position for the light-house is at the point, where a line drawn on the usual sailing course of vessels, proceeding up the bay, bisects the mouth of the channel between the Brandywine and Brown shoals, and strikes the former at the assumed depth. To determine this point, it will be necessary to lay down the lower half of the channel between the Brandywine and Brown, including the seaward points of those shoals, and the western side of the former, with their relation to the meridian and the shore. This operation will consist, in the first instance, in fixing the position of not less than four permanent stations, well selected on the above-named shoals, from which the detailed hydrography, so essential to a correct determination of the point in question, will be carried on. These permanent stations will, each, consist of a single tripod of timber, 35 to 40 feet in height, properly strutted out and weighted at the foot, with a fourth spar rising from the apex, and surmounted by the usual tin cone to insure its being seen distinctly from the shore. To one or more of these will be attached the tide registers, necessary to a correct reduction of the soundings to any given plan. Of the permanency of these tripods under all circumstances, except against ice and the worm, no doubt is entertained.

The next operation in order is to mark out the site with piles, to guide in placing the caisson and depositing the stone which will surround it. The small number of these piles will allow of their being driven in a few days, by a pile engine placed on a flat form, resting on timber tripods of the kind already described, but smaller in size. To insure the completion of these operations in proper season, they should be commenced as early in the spring as the boisterous character of the locality will permit.

The placing the caisson in position is an operation of great delicacy; and on giving, at once, the necessary protection to the bottom around it, depends the success of the work. It is in fact the turning point in the undertaking, in comparison with which, the subsequent risks and difficulties are of small moment. No means should, therefore, be neglected to insure it against failure; and a shortsighted economy would prove fatal to it. These means have been the subject of much anxious reflection, and, being predicated on the truth of the proposition that the soil composing the shoal is capable of sustaining the work, are all directed to the single object of retaining this soil in its natural position. In what manner it is proposed to effect this object will now be explained.

The caisson, provided with the necessary moorings and machinery for hoisting stone, having had laid on board as much of the foundation as will cause it to draw about 15 feet water, will be towed by one or more steamboats to some convenient harbor in the immediate neighborhood of the Brandywine shoal. This point will likewise be the rendezvous for vessels carrying breakwater stone, and that portion of the foundation coming next in order in the construction. Here the final arrangements will be made, and taking advantage of a settled state of the weather, the whole will move down to the scene of operations. The site, it will be remembered, has already been marked out. It will, also,
be borne in mind, that the caisson is supposed to be loaded to a draught of 15 feet, or 3 feet more than the depth at the proposed site, at the lowest spring tides. It will be evident, therefore, that the caisson cannot be placed in position at less than half tide; and, to allow sufficient time for securing it over the selected spot, this should be done on the flood. At half ebb the caisson will fall on the bottom, when the work of loading it with additional foundation stone will be prosecuted with great diligence, in order to prevent, if possible, its floating again on the rise of the tide. To effect so desirable an object, it will be necessary to take on board about 200 tons in the time that will elapse between half ebb and high water, or about 8½ hours. For this purpose two boom-crane, attached to the caisson, will be employed. These, fully manned and unloading from separate vessels, will be able, in a favorable state of the weather, to take on board in the time above stated, 85 stones weighing 255 tons; affording a large excess of weight as a set-off against the difficulties and delays incident to so exposed a position, over and above the quantity required to retain the caisson on the bottom at any stage of the tide. The stone thus transferred to the caisson, will be placed conveniently on the decks for being laid by the masons. The eight mooring piles, attached to the caisson, will now be driven, by the engine provided for the purpose, in order to prevent any lateral motion to which it may be liable from currents or waves, until the further loading shall make it perfectly secure. If from stress of weather, or other cause, the amount of labor calculated upon above be not accomplished, arrangements will be provided for flooding the caisson, to insure its safety until such time as the work may be resumed.

The caisson being now secured, the next object is to prevent the sands of the shoal from being carried away by any new action given by its presence to the current or the waves. This will be effected by piling the shoal with breakwater stone. To this end about seventy-five vessels will be provided, which, estimating their average load at sixty tons, will carry 4,500 tons, a quantity sufficient to cover the bottom to a depth of three feet for sixty feet around the caisson; allowing that this space will accommodate ten vessels at the same time, and that two hours would be required to unload a vessel, this quantity may be deposited, in moderate weather, in sixteen hours. The early completion of this measure is deemed so important to the success of the undertaking, that a large force will be employed to prosecute the work as rapidly as possible; and to insure, as far as practicable, a uniform distribution of the stone over the designated space, the place of each vessel and of her deposit will be represented on a diagram. No importance is attached to any minor irregularities which may occur in the paving, as the tides in flowing over the general surface of the shore, so far from removing the sand, will cause deposits in the spaces between the stone. And again, with a view to compensate for any loss which may have occurred before the paving is completed, a result not anticipated, but principally to prevent the great sill-piece from the attacks of the worm, clean sharp sand will be deposited in large quantities along side the caisson. The vessels, as they successively deposit their loads, will return to the quarries for more stone to form so much of the final mole as is considered necessary to
place the work in a condition of safety against the storms of the approaching winter. This quantity is set down in the estimate at about 33,000 tons, and may be deposited in eleven weeks, or at the rate of 3,000 tons a week, the average quantity frequently received at the Delaware breakwater. The laying of the stone of the foundation rock will be resumed immediately on the caisson becoming fixed upon the shoal, and the work rigorously prosecuted until completed. As two and a half courses will be laid before proceeding down the bay, but seven and a half of the ten courses will remain to lay after arriving at the shoal. These consist of 500 blocks, and as they will be furnished with lewis and cramp holes, and lettered and numbered, agreeably to diagrams in the hands of the workmen, the hope is entertained that even half the time stated above may be sufficient to finish this part of the work.

In thus laying down a plan of operations, it is not for a moment supposed that it will be expedient, or at all times practicable, to adhere to it. The object is more to elucidate general views in regard to the principles which should govern the mode of proceeding, than to point out the details, which, in a work of so novel a character, must depend upon circumstances which cannot always be anticipated, and be provided on the spur of the occasion.

It now remains to give a revised estimate for the entire work, under the modifications and increase in prices already noticed. No revision has been made in the plan of the light-house proper, or lantern, nor is it probable that any changes in either will be found necessary, that will materially affect the cost of the work. The present object is the successful establishment of the foundation, in which consists the only real difficulty in the construction.

**Artificial island, or protecting mole.**

14,784 tons of breakwater stone, of pieces of 2 tons and upward, at $3 per ton .......... $44,202 00
25,037 tons of breakwater stone, of pieces of \( \frac{1}{2} \) to 2 tons, at $2 per ton................. $50,074 00

Cost of artificial island, or protecting mole................. $94,276 00

**Foundation.**

Cost, as already stated.................................. 43,977 73

**Light-house proper.**

The original amount under this head was.............................. 21,787 75

From which subtract (now estimated for in the foundation) the cost of 340 cubic yards of heavy building stone, at $5 20 per cubic yard... $1,768 00
And for laying the same, at $17 20 per cubic yard................. 5,848 00
Also, for laying 148 cubic yards of superstructure, reduced from $17 20 to $8 60..........................$1,272 80

$8,888 80

Cost of light-house proper.......................... $12,898 95

Lantern.

Cost, the same as originally estimated......... 1,340 39

152,493 07

Contingencies, 17 per cent.......................... 25,923 82

Total amount........................................ 178,416 89

It is not improbable that complete security may be given to the structure short of the fulfilment of the profile on which the above estimate is founded, and that the protection given in the first instance may prove amply sufficient, reducing correspondingly the aggregate expense. The grounds for this hope may be found in the fact that the proportion of two to one gain to the exterior slope of the latter work is the same up to the 30th September, 1836, as that of the Delaware breakwater, a work certainly exposed to greater shocks, though, on the other hand, more secure, from the greater depth of water in which it is founded. The result may likewise show that the mason's work is set down at too high a rate. Nevertheless, it is deemed safest in a work constructed under such novel circumstances as the Brandywine light-house, to retain both the items at the highest rates, to meet any unforeseen contingencies to which the operation may be liable.

I have the honor to be, sir, very respectfully, your obedient servant,

HARTMAN BACHE,
Major Topographical Engineers, &c.

Colonel J. J. ABERT,
Topographical Bureau.

IN SENATE OF THE UNITED STATES.

MAY 18, 1840.—Submitted, and ordered to be printed.

Mr. Davis made the following report:

The Committee on Commerce has examined the several communications of Mr. Lepaute to Mr. Davis, and beg leave to submit the following report:

In 1838 this committee made a report recommending the importation and trial of lenticular lights from France, believing the experiments which had been tried in the light-houses of that nation had fully established their superiority over reflectors. Pursuant to this recommenda-
tion, Congress passed a law authorizing the importation of two sets of apparatus, which, after great delays, have arrived at New York, but have not yet been set up. This apparatus has been constructed under the supervising care of a gentleman most favorably known in Europe, as the superintendent of the construction of lenticular light-houses in France, Mr. Henry Lepaute. Being made acquainted with our desire to make a fair trial of this apparatus, through Captain Perry, of the United States Navy, who was instructed to contract for two sets, he, in the most obliging manner, tendered his valuable services to see that the work was done in the most approved manner. One set is for a fixed light of the second order, and will, it is understood, be set up shortly at Sandy Hook, upon the great track of vessels entering and departing from New York, where its merits will be brought under the observation of shipmasters and mariners, standing, as it will, in direct contrast with the lights upon Navesink. This position will, therefore, be favorable in all respects for a trial, except, it is feared, the tower is not sufficiently elevated above the sea, to give its greatest range to such a light. The other is a revolving light of the first order, and the Isle of Shoals, near Portsmouth, New Hampshire, has been thought of, as a suitable place for it, but the height of the tower is inadequate to display the light in the most useful manner. This site is recommended, because it lays in the track of a great commerce, and in a region subject to that weather and fogs which will bring the power of the light to the severest test. All these matters are however confided to the care of the Fifth Auditor, Mr. Pleasanton, who appears to take a commendable interest in them, and feels anxious that the lights should be fitted up in the best manner, and a fair and full trial of them be made, and the committee have no fears as to the result.

If well-authenticated evidence may be relied on, the brilliancy of the beam of light formed by the lenses has never been surpassed in light-houses, and we are deeply indebted to the learning and perseverance of those able, scientific gentlemen in France, who have devoted themselves with zeal and signal success to the improvement of light-houses.

Mr. Lepaute, who has given us many proofs of the value of his services in this department, asserts the extraordinary fact, that the first class of lenticular lights may be seen with the naked eye fifty miles; the second, forty miles; the third, twenty-eight miles; the third, small, twenty-five miles; the fourth, revolving, twenty miles; the fourth, fixed, fifteen miles; while it appears that none of ours are visible more than twenty-seven or twenty-eight miles, and most of them from ten to sixteen miles only. Therefore, the third order, and even the third, small, is equal to our best; and the quantity of oil consumed, Mr. Lepaute represents to be at least one-third less. It will be seen by the annexed table, that he has computed, in kilogrammes, the quantity of oil consumed by each of our light-houses in a year, the aggregate of which is equal to 242,054, and also the quantity necessary for lenticular lights of equal power, which is equal to 130,800 kilogrammes.

This presents to us a strong motive to persevere in the trial till we have seen for ourselves the results.

If they turn out as favorably as we have good reason to believe, we
shall soon lay aside our reflectors for lenses, and probably diminish the number of our establishments considerably; our outer or sea lights, which are first seen by mariners approaching to the coast, ought mostly to be of the first and second order, to give early warning to vessels. Those which are employed to indicate the channels and head-lands of our inland waters may be chiefly of the smallest order.

It is understood that Mr. Plessenton has engaged an experienced artist to come over from France and set up the imported apparatus, which the committee consider a very judicious step, as this work requires skill and experience, and it is also essential that some one should be capable of instructing the keepers in their duties. Mr Greenough has offered to fit the lamps for his chemical oil and to try the experiment with it. This oil has been subjected to test in the light-house at Boston, and burns with an intense brilliancy greatly surpassing sperm oil. It is desirable to see these improvements united, as the happiest results may be anticipated.

Several of our enlightened citizens have turned their attention with much zeal to the improvement of our light-houses. Of these Captain Perry, of the United States, was employed to contract for the several sets of apparatus imported by order of Congress; and, while abroad, it is understood collected much valuable information. The committee have on their files, translations of several French documents, communicated to them by Messrs. Blunt, of New York, which, so far as they are not similar to those before in their possession, they shall annex to this report. These gentlemen have devoted much of their time to this subject, and have collected much valuable information which they have at all times freely communicated for the benefit of the United States.

The committee take much pleasure in laying before the public the subjoined papers, from the pen of Mr. Lepaute, believing that they will add to the stock of general information, and draw the attention of the learned to this important subject. Our system has not kept pace with the improvements of the age, for we have for a long time made little advancement, while France and England have given an efficiency to their lights never before equalled. Having a great mercantile marine and a great extent of coast, it is our interest, as well as our duty, to light, in the best manner, the dangerous path of the mariner; and the committee take pleasure in giving encouragement to every useful improvement designed for that end.

[Translation.]


SIR: Pray excuse the liberty which I take in addressing to you, enclosed, a comparative table of the annual expense of oil for the light-houses of the United States, compared with a like number of lenticular light-houses of a corresponding brilliancy and portée, or reach.
The important report which you made on the 22d March, 1838, at the 2d session of the 25th Congress (which Captain Perry did me the honor to communicate to me) on lenticular light-houses, demonstrates the interest taken by you in a system which presents such great advantages, not only in an economical point of view, which might be considered secondary in so important a service, but in the much more essential one of having good lights, considerations which you have pointed out in a manner so clear and precise, in demonstrating the advantages which navigators might derive from them.

The table which I have the honor to submit to you, comprises two principal divisions placed opposite to each other; the first, for light-houses with reflectors; the second, for lenticular light-houses.

The first division indicates, beside the name and character of the lights, the distance at which they can be seen, the number of burners which light these light-houses, and the annual consumption of oil in kilogrammes.*

The second division indicates the character of those light-houses generally similar to that of light-houses with reflectors, their degree of distance in English marine miles at which they can be seen, the order to which they belong, and the annual consumption of oil for each of them.

The work published this year by Mr. Coulier, entitled "A General Description of Light-houses," comprises a greater number of them than that comprised in the comparative table, but the names by which some are designated, not being the same as in your report, I have not been able to complete my work, for fear of giving to some light-houses a character different from that which they really have.

Notwithstanding that, I have, I fear, committed some errors on this subject, but I hope they will be few.

I have found more positive information, which alone has permitted me to complete this comparative table, in your above-mentioned report of the 22d of March, 1838, concerning the number of burners which illumine each light-house.

I have supposed that each of these burners was an Argand lamp, consuming 85 grammes of oil per hour, or 140 kilogrammes per year, and at 4,000 hours by night, the time during which the light-houses are lighted.

The lenticular light-houses are designated by their numbers of order, as 1st, 2d, 3d, and 4th order. The light-houses of the 3d order are divided into two series; the first is on a large scale, and the second on the small scale, as indicated in the table by the sign 3p, (small model.)

Permit me, sir, to present to you some observations relative to the two lenticular apparatus of the 1st and 2d order, which I have executed on account of your Government, and which were sent to New York in the month of August last.

I have added, also, some drawings, and some very detailed notes on the manner of arranging the apparatus for lighting, and particular instructions about the management of mechanical lamps which are used in their illumination.

My information relative to arranging the apparatus for lighting, leaves me no grounds for uneasiness with regard to this work; but it is not the

* A kilogramme is equal to two pints
same with lighting, and the care of lamps, although the instructions
given for this object embrace all the details of their management, and
make certain provision against every accident which may occur; a
practical instruction would have been one guarantee the more.

I proposed to Captain Perry to send, during eight or ten days, either
into my manufactories, or into one of the lenticular light-houses near
Havre, such as Barfleur or Fécamp, one of the mates or sailors of the
ship in which the apparatus for lighting was to be embarked, in order to
be transported to New York. This precaution, though not very expen-
sive, would have been a guarantee of a good method of lighting, without
which a light-house cannot give all the light of which it is susceptible.

The position of the burner of the lamp in the apparatus for lighting,
is what is most important to be observed. For the light-house of the 1st
order, the upper part of the burner should be 28 millimetres (a millimetre
being the thousandth part of a metre) below the middle of the central of
the large lenses. And for that of the 2d order, the upper part of the
burner should be 26 millimetres below the middle of the central lens.

In order that the lenses may produce all the light of which they are
susceptible, the flame should be 12 centimetres (a centimetre is the hun-
dredth part of a metre) high for the 1st order, and 10 centimetres for
the 2d.

In order to ascertain whether a lamp is in full effect, an ordinary
Argand lamp being taken as the unit, the distances at which the same
degree of shadow is produced by both upon a screen is observed, and the
result of calculations made on these observations gives, as the measure
of intensity of the lamp of the 1st order, twenty-five times that of the
Argand lamp taken as the unit, and fifteen times for the lamp of the
2d order.

You will doubtless see, sir, that I confine myself to details of little
importance, but I beg you to believe that they are indispensable, in order
to obtain from apparatus for lighting those brilliant flashes which are
the objects of admiration to the mariners who frequent our ports.

If I had not seen by your report to Congress the great interest which
you take in the lenticular system, I would not have permitted myself to
enter into the practical part of this service.

I have the honor to be, with the most distinguished consideration, sir,
your humble and very obedient servant,

HENRY LEPAUTE.

Mr. Davis,
Member of Congress of the United States.

TREASURY DEPARTMENT, January 22, 1840.

The Secretary of the Treasury has the honor to report to the President
of the United States the following statement of facts in relation to the
subject referred to him on the 20th instant, concerning the building of a
light-house and beacon, by the Fifth Auditor. In the spring of 1837,
it became necessary, under an act of Congress, to have the examination
and views of certain officers of the Navy in respect to the expediency of erecting a light-house on Robbins's reef, and a beacon on Romer shoal, in the State of New York.

Captains Kearney, Sloat, and Perry were detailed for that duty; and on the 2d day of May, in that year, made a report in favor of the former, and on the 2d June made a report in favor of the latter. Copies of these reports are among the papers referred to me. It appears that the Fifth Auditor afterwards proceeded, through the collector of New York, to make contracts for the erection of the light-house and beacon aforesaid; and in the summer of 1839, when they were both far advanced towards completion, Captain Kearney addressed a letter to Commodore Morris, one of the Navy Board, expressing doubts whether the location of the beacon was judicious and useful, and whether the light-house was the kind of work which had been previously recommended by him and his associates. A copy of this letter, dated August 17, 1839, is also among the papers. Two days after, he addressed a second letter, on the same subject, to Commodore Morris, a copy of which is annexed, in which he expresses an opinion against the location of both the light-house and beacon, as well as the buoys generally in that harbor, and up the Raritan bay. In the first letter he suggests, likewise, the propriety of suspending the work on the shoal. These letters were laid before the Acting Secretary of the Navy by Commodore Morris, and one or both of them communicated, by the former, to the Treasury Department, inviting its attention to the subject. Accordingly, on the 24th day of August, 1839, the Secretary of the Treasury requested the Fifth Auditor to examine into it and make a report. On the same day he made the report, a copy of which is among the papers, and in which he undertakes to justify the location of the beacon and the materials and workmanship of the light-house. He appears also to have called on the collector at New York, who had acted under him on these subjects, to a certain extent, to make inquiries and present a report in relation to the matters complained of. That report was submitted, by the Auditor to the Treasury Department, on the 25th of September, 1839, with a request to lay the same, and his own previous report, before the President. This was done by the Secretary of the Treasury, and they were likewise laid by him before the Secretary of the Navy. Copies of that request, and of the collector's report, are among the papers annexed.

On the 10th day of January, 1840, the Fifth Auditor addressed a letter to the Secretary of the Treasury, which is among the papers, requesting to be informed what the opinion of the President was in relation to the subject. He was informed that none had been communicated to the Secretary. On the 20th instant he addressed another letter to the Secretary, which is enclosed, expressing an earnest conviction, “it is of importance now for the President to decide whether Mr. Hoyt and myself (Mr. Pleasonton) stand exculpated, or whether Captain Kearney is justified in the representations he made.” In pursuance to this reference, a report of the leading facts and dates, with a specification of the papers, in which all the details and all the certificates and arguments can be found, has been prepared, and is now presented.

It is not necessary to repeat those details, certificates, and arguments,
in the report itself. But in the perusal and consideration of them, before expressing the opinion thereon which is desired, the Secretary of the Treasury has endeavored to overlook any personal allusions and acrimony they may contain, not bearing directly on the question in controversy, and to state his conclusions upon the merits alone.

His conclusions are, that the Fifth Auditor, as well as the collector, stands exculpated from all the charges; and that although there is some evidence against the location of the beacon being the best, for all purposes, which could be selected, yet that due care was exercised in selecting the most suitable site for a beacon on the shoal, which, in its cost, should come within the appropriation, and at the same time be useful to certain portions of the navigation.

The President concurs.—M. V. B.

---

Communication from the President of the United States, transmitting in compliance with a resolution of the Senate, a copy of the report of Captain M. C. Perry, in relation to the light-houses of England and France.

JULY 20, 1840.—Ordered to be printed.

The President of the United States, in pursuance of a resolution of the Senate of the 20th instant, herewith transmits to the Hon. Secretary of the Senate, a copy of the report of Captain M. C. Perry, in relation to the light-houses of England and France.

WASHINGTON, July 25, 1840.

M. VAN BUREN.

---

TREASURY DEPARTMENT, July 25, 1840.

SIR: I have the honor herewith to transmit to your excellency a copy of the report made by Captain M. C. Perry, in relation to the light-houses of England and France.

I have the honor to be, most respectfully, your obedient servant,

LEVI WOODBURY,
Sec. of the Treasury.

The President of the United States.

---


LIGHT-HOUSES OF GREAT BRITAIN AND FRANCE.

Among other duties required of me while absent in Europe, I was instructed to examine into the condition of the English and French
light-houses, with a view to the introduction into the American light-house system, of the various improvements which have been more recently adopted by the light-house departments of those countries.

Although deeply occupied with other official engagements, I was careful to reserve sufficient time to enable me to communicate personally with the light-house boards of England, Scotland, Ireland, and France, and to visit a few of the light-houses under the respective management of these institutions, from the officers and members of which I received the utmost civility, with every aid, in furtherance of the objects of my inquiries. Estimates, books, plans, charts, and drawings were freely tendered, and every one seemed to evince a lively interest in directing my attention to whatever was most worthy of notice, justly remarking, as they did, that all improvements in the means of lighting the coasts of any country, however immediate and local might be the benefit, was still a matter of general concern to navigation, and should receive the support and encouragement of all maritime nations.

It is only within a few years that the condition of the light-houses of England and France has attracted much of the attention of these governments. In England they have been generally held by private corporations or individuals under special privileges granted by the Crown, and in consideration of their establishment and maintenance in good and sufficient order, the proprietors have been permitted by law to exact certain dues from all vessels benefited by their lights.

In the early and limited state of the commerce of Great Britain, these dues might not have been considered exorbitant, but as the amount of shipping increased, and the number of lights were multiplied, all to be supported from the same source, the burden became more and more onerous, and these monopolies, granted at first as equitable remuneration to the proprietors, gradually grew into unjust exactions upon commerce. Enormous revenues were and still are derived from these monopolies;* and the British Parliament, after a long while permitting the abuses to go on unchecked, at last commenced its endeavors to correct them; but the evil has been too deeply rooted to be eradicated without some strong legislative measure. The vested rights of the parties (rights nowhere held more sacred than in England) have hitherto interposed insuperable barriers to efficient reform, and though the investigations of Parliament through its committees have produced very important changes for the better, the most prominent objections to the whole system have not been removed.

With the exception of the private and local, or harbor-lights, the light-houses of Great Britain are managed by their regularly organized associations, viz:

The ancient corporation of Trinity House of Deptford Strond, chartered in the reign of Elizabeth.

The commissioner of the northern lights, incorporated in 1810 this board having its principal office in Edinburgh.

And the corporation for preserving and improving the port of Dublin, which commenced its duties in 1810.

*The gross annual receipts for 134 lights amounted, in 1834, to £340,304; expense of maintenance, £74,832; of collection, £32,135: net profit, £149,436.
The following table, copied from official records, made up to the year 1834, will show the number of light-houses and floating lights on the coasts of the United Kingdom at that period; a few others have subsequently been established:

**Lights in the United Kingdom.**

<table>
<thead>
<tr>
<th>Under direction of—</th>
<th>Light-houses</th>
<th>Floating lights</th>
<th>Total light-houses</th>
<th>Total floating lights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>England</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trinity House</td>
<td>42</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under management of Trinity House</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In private hand, viz:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On lease from Trinity House</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On lease from the Crown</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patent, or act of Parliament</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local or harbor lights</td>
<td>51</td>
<td>4</td>
<td>108</td>
<td>18</td>
</tr>
<tr>
<td><strong>Scotland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under the commissioner of the northern lights</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local or harbor lights</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ireland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under the corporation for preserving and improving the port of Dublin:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>23</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harbor lights</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harbor lights (no revenue) maintained by the local authorities</td>
<td>5</td>
<td></td>
<td>37</td>
<td>3</td>
</tr>
<tr>
<td>Light-houses</td>
<td></td>
<td></td>
<td>198</td>
<td>21</td>
</tr>
<tr>
<td>Floating lights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>219</td>
<td></td>
</tr>
</tbody>
</table>

The light-houses of Great Britain were in early times illuminated by various modes, by candles, lamps, and by beacon fires of wood or coal, made upon the summits of the towers. In succession of time, the different contrivances for lighting have been gradually improved both in England and France; and a question is now presented whether the French lenticular apparatus or the improved English parabolic reflectors are to be preferred. I made it my duty to examine into the operation and effect of both these plans, and the result of my observations, added to the best information I could obtain, decided me in favor of the French system. The brilliancy of both, however, is so remarkable, compared with the dimness of the American lights, that no one can avoid noticing the difference, although in the United States, the parabolic reflector, if such it can be called, is universally in use. The imperfection of its form and the inferiority of its construction, as to material and workmanship, are so apparent that it has always been a matter of surprise among nautical men why the evil has been so long permitted to exist, while in most other respects we have taken the lead in practical improvements.
But if the lighting apparatus of the light-houses and floating lights of England and France may be pronounced so far superior to those in use in the United States, how much more remarkable is the difference of management of the establishments of these respective countries; in the two former, the most rigid discipline and vigilance are observed; in the latter, I am bound to say, there is little of the one or the other. While in Europe the severest penalties are inflicted upon a light-house keeper who shall absent himself even for an hour from his post, in this country it is notorious that some of our principal light-houses are left for days in charge of incompetent and irresponsible persons not recognized by the regulations of the superintendent at Washington.

It is a peculiarity of the people of this country, that a proper regard to the preservation of human life enters too little into the concerns of the every-day transactions of the community. We are constantly hearing the most melancholy disasters on board of steamers and in vessels approaching the coast, by which numerous lives are sacrificed, not so much to the inscrutable chances of ill-fortune proceeding from inevitable causes, as from the unpardonable negligence of those whose duty it should be to guard against those catastrophes. And so in regard to the care of lights which are established to guide the anxious seaman along the dangerous coast or into the distant port. How responsible is the trust of those who undertake the charge, and yet how little is the trust regarded!

In making these remarks, called for, as I believe, upon a point of duty, I desire to be considered as disclaiming any intention of imputing censure to any one. Such a course would be presumptuous in me. The fault lies in the system, which has belonged to no particular period of our Government, but has grown into its incongruous form for want of suitable legislation. At last, however, some measures have been taken toward reform; and it may be said that greater advances have been made in the last two years in improving the character of our lights than for a long period before; but the very effort to bring about these changes has, in the process of investigation, exposed to view the imperfections of the system, and elicited conflicting opinions and feelings, however to be regretted, yet productive of ultimate good.

And we may now hope that the gradual improvement of our lighthouse system, with the perfection of the charts in progress of construction under the direction of Mr. Hassler, may render the coasts of the United States less dangerous of navigation.

Being under instructions from the Navy Department to execute certain duties in Europe connected more immediately with my profession, I was empowered by the honorable Secretary of the Treasury, through the superintendent of lights, S. Pleasonton, Esq., to procure and bring to this country specimens of such lamps, reflectors, &c., as were in approved use, both in England and France, and to contract in London for the construction of a complete set of English parabolic reflectors and lamps, and at Paris for two sets of the French lenticular apparatus. All these instructions I fulfilled to the best of my judgment.

Through the friendly assistance of Jacob Herbert, Esq., secretary to the Trinity Board, to whom I was under many obligations while in England, I procured from Mr. Wilkins, the manufacturer for that corporation and
the Government, fifteen 21-inch parabolic reflectors with the requisite lamps, and various other articles of which a list may be found in paper marked CC. Fourteen of these reflectors and lamps now compose the lighting apparatus of the Boston light-house, and the other has been exhibited by Mr. Greenough at Washington, with a French reflector, procured by me at Paris, and one of American manufacture furnished, as I understand, by Mr. Winslow Lewis. As this exhibition was witnessed by numerous persons it will be useless for me further to refer to it here.

In negotiating at Paris for the two sets of French lenses, I was equally fortunate in securing the assistance of a distinguished engineer, Monsieur L. Fresnel, to the elder brother of whom is justly ascribed the invention and application of this beautiful apparatus. Monsieur Fresnel not only favored me with his valuable advice, but, feeling, as he said, a deep interest in the perfection of the machines ordered by the American Government, generously undertook to superintend their construction, and to guaranty the faithful fulfilment of the contract; and I am informed by him that they will possess several valuable improvements, and be superior to any that have ever been made by the well-known manufacturer, Monsieur Lepaute.

It will not be expected that I should attempt a description of these machines; the books and drawings which accompany this report will furnish explanation more satisfactory, and it will be only necessary for me to remark here that the effect of similar apparatus when lighted is beautiful in the extreme; and however brilliant may be the light produced by the reflectors brought by me from England, that from the lenticular apparatus will be still more so.

In regard to the comparative merit of the lenses and the reflectors I have already remarked that the preference is generally given to the former. Though the construction and fitting up of the lenses will cost a large sum of money in the beginning, the saving in the consumption of oil will soon make up the difference.

It will now be my purpose to refer to the light-houses and floating lights visited by me; and here again I take pleasure in acknowledging my obligations to Mr. Secretary Herbert, and to Captains Drew, Weller, and Madden, elder brethren of the Trinity House, the latter three having accompanied me in one of the steamers belonging to the institution on a visit of inspection to the floating lights on the Thames. To Messrs. Cunningham and Maconachée of the board of northern lights, to Mr. Wilson, United States consul, and member of the Dublin light-house board, Captain Beaufort, royal hydrographer, and, as before mentioned, to Monsieur L. Fresnel, and to many others in both countries, I was also greatly indebted for valuable services rendered.

I was also under many obligations to Mr. Eugene A. Vail, an American gentleman residing at Paris, who kindly devoted his time and valuable services in assisting in making the arrangements for the lenses, not only while I was in France, but after I had left that country.

With a view to brevity, I shall notice only one of the light-houses under the superintendence of each of the respective corporations in the United Kingdom, also an English floating light and one of the principal
light-houses of France. These will be the light-houses at South Stack, near Holyhead, on the coast of Anglesea; the Inskieith, near Edinburgh; that at Poolbeg, in the vicinity of Dublin; one of the floating lights on the Thames; and the light-house of Barfleur or Gattville, near Cherbourg, in France.

SOUTH STACK OR HOLYHEAD LIGHT.

This light-house is situated about two miles nearly south from the light on the outer end of the pier at Holyhead. It is placed upon a high projecting rock separated from the main land by a chasm, through which the sea passes and over which is thrown a beautiful iron bridge. The heavy surf constantly dashing against these rocks prevents any communication with the light-house by sea, excepting in very calm times; consequently, it is usually approached from the land side and across the bridge, to arrive at which the visitor has to make a circuit round the adjacent mountain and to descend to the end of the bridge by steps, five hundred in number, which are cut in the solid rock.

Beside the light-house, there are several other buildings on the rock, among them a very pretty cottage intended for the accommodation of the agent, Captain Evans, and the whole appearance of the establishment affords ample proof of the disregard of labor and expense evinced in the completion of this splendid and useful work.

The tower of the light-house is in height 60 feet; this added to the elevation of the rock on which it is erected, 140 feet, makes the centre of the lantern about 207 feet above the level of the sea at high water.

The lantern is in height 14 feet, and having the same diameter. The lighting apparatus, which is revolving, is composed of twenty-one 22-inch reflectors, with Argand lamps, seven in each face; and the revolutions are performed once in six minutes; during each, three obscurations, at intervals of two minutes, are observed. These are produced by the peculiar arrangement of the reflectors.

The apparatus is kept in motion by clock-work in the usual way, being accelerated or retarded in its movements by a revolving horizontal beam, having at each end vertical wings, which are placed at certain angles with the beam, to regulate, by their relative obstruction to the atmosphere, the velocity of the machine.

Near to the main light-house, on the side of the cliff toward the sea, a small movable house is placed upon an inclined plane, and is held in its position by strong chains, by means of which, and a windlass, it is moved up or down the side of the cliff. Its position being regulated by the state of the weather, as in high winds it is necessary to elevate it to avoid the effects of the surf breaking violently over the rocks.

In this house, which has plate-glass toward the sea, are fitted three 22-inch reflectors, which, by an ingenious contrivance of machinery, perform constantly a circular motion from right to left and back, describing, in this reciprocating movement, about two-thirds of a circle.

The object of this light is to warn vessels of their near approach to the cliff, when by possibility they cannot discern the more elevated lights at the summit of the tower, as it is a peculiarity of this coast, that at
times a stratum of fog will float at some distance above the sea, when nearer to the surface the atmosphere is more clear.

The same reason was assigned to me by Captain Denham, R. N., surveyor of the port of Liverpool, for placing the lantern of the light-house on Point Elliot's (which I also visited) so near the ground.

As an evidence of the solicitude shown by the Trinity board to adopt every possible precaution to guard vessels from danger, the gulls are encouraged to build their nests in fissures of the rocks near the light; care is taken not to disturb them, and by proper caution in this respect, they fearlessly rear their young within a few feet of the buildings, and the spot being known by the pilots and fishermen as the resort of these birds, the noise which they make, more especially in bad weather, gives warning to those on board of vessels brought in unexpected proximity to this dangerous point.

The South Stack was lighted for the first time in 1820, and has since required no repairs.

The whole appearance of this establishment displays a degree of liberality, neatness, and order, highly honorable to the Trinity board. In truth, there is something in the character of all the institutions of this great country that conveys an idea of completeness and stability not generally to be found elsewhere.

Among other English light-houses visited by me, I should particularly mention, as having drawings of the establishment, that at Start point, near to Plymouth, in the British channel. The lighting apparatus is arranged after the French plan, and, though not entirely complete, exhibits a beautiful light.

**INSKEITH LIGHT-HOUSE.**

Engagements connected with other objects of duty did not permit me, while in Scotland, to examine very closely into the light-house system of that country; nevertheless, I collected some valuable information, and had an opportunity of visiting the light-house on the island of Inskeith, in the Frith of Forth, a few miles from Leith.

This light is elevated two hundred and forty feet above the level of the sea, and may be seen in clear weather fifteen miles. It was formerly lighted by reflectors, but in 1835 these were removed to give place to a revolving apparatus of the second order, upon the dioptic principle.

The change has been generally thought to have improved the character of the light. Indeed, so much favor did the new apparatus find after satisfactory experiment, that several others have since been established in the kingdom, and by the Government in the colonies.

The lenses are composed of seven series, forming together a heptagon, the whole revolving once in seven minutes, producing seven successive flashes, with alternate partial obscurations at each entire revolution. These obscurations are caused by the almost total disappearance of the rays of light when the eye of the observer is in line with the angles of the lenses. The alternations of light and darkness are more distinct at a distance of ten or twelve miles; when viewed nearer, the divergent rays of the lenses and mirrors furnish a faint light, which is found useful
to pilots, who calculate, from the extent of obscuration, their distance from the island.

The apparatus is not complete, having mirrors only above the lenses, the old lantern not being sufficiently high to admit of them below.

The light is produced from a cæcel, a mechanical lamp of the first order, with concentric wicks, and its consumption of oil is equal to one gallon in eight hours.

The principal keeper of this establishment has been employed in the service twenty-two years, and being an intelligent man, as, indeed, are most of the light-house keepers in the kingdom, I put various questions to him; among others, I inquired his opinion in respect to the relative properties of the lens apparatus and the reflectors, and, though evidently prejudiced in favor of the latter, he did not deny that the former gave the most brilliant light.

The same vigilance is observed in Scotland as in other parts of the kingdom in regard to the faithful care of the lights. The keeper at Inskeith told me that he had never known an instance of a lantern being left when burning. The keeper of the watch is not even permitted to leave his station to call his relief, but communicates with him by means of tubes fitted in the wall of the building, and leading to the respective sleeping apartments.

Nota.—It had been the intention, as I was informed by Mr. Cunningham, the secretary of the board of northern lights, to furnish me with drawings and estimates similar to those received from the Trinity House and the Dublin board, but they did not reach me before I left England, nor am I aware that they have yet been transmitted. I received, however, from Mr. J. Maconachée, a copy of the report of Mr. A. Stephenson on dioptic lights, and a beautiful set of charts, showing the light-houses on the coast of Scotland; all of which are transmitted herewith.

LIGHT-HOUSES OF IRELAND.

The same causes which prevented my making any other than a brief examination of the light-house system of Scotland, rendered it necessary that my visit to Ireland should be still more hurried, and I had hardly time to communicate with some of the members of the light-house board of Dublin, and to visit one light-house, that at Poolbeg, in the vicinity of the city.

Although this is called a harbor light, it is one of great brilliancy, being lighted with twenty-six 22-inch reflectors; these are placed on two horizontal hoops, 13 in each circle.

Beside the twenty-six reflectors in the lantern, there are three others of 24-inch diameter, placed in an opening in the wall of the tower, a little more than a third of its height from the base. These lights front the mouth of the harbor, and are intended to show the time of tide. They are illuminated from the time of half-flood to the succeeding half-ebb.

In the daytime a ball is hoisted at the top of the light-house to show the same periods of the tides.

On the balcony which surrounds the lanterns two bells are placed, each
of 500 pounds in weight; these are struck in thick weather by trip-hammers which are worked by the revolutions of a horizontal shaft crossing the floor of the lantern. This shaft is kept in motion by clock-work contained in a small case, and is similar to the apparatus used for revolving lights. The two ends of the shaft project nearly across the balcony; and at each revolution it trips two hammers in succession, one at each end, which strike alternately, and as the shaft revolves twice in one minute, the hammers make four blows in the same time. I was informed that the consumption of oil in the lamps attached to the 29 reflectors was equal to three gallons in twelve hours.

There is so little difference in the mode of management of the lights in Ireland, and those in England and Scotland, that I shall content myself by simply remarking, that the establishment at Poolbeg, exhibited in all its essentials a degree of system, neatness, and order, not inferior to any I had seen elsewhere.

VENTILATION.

All the light-houses in Great Britain are well ventilated, not only with a view to furnish a sufficient circulation to aid the combustion of the oil, as to preserve a healthful temperature throughout the building. The ventilation of the lantern is produced by movable valves, placed at convenient points, either under or above the balcony, or in the floor of the lantern. These are opened or shut at pleasure. Stoves are used in winter.

ENGLISH FLOATING LIGHTS.

These vessels are equally perfect with the light-house under the direction of the Trinity House. I had an opportunity of visiting several of them, and as they are generally alike in construction and equipment, I shall attempt a brief description of one only, a new vessel, "the Levin Middle," being so called from the name of the shoal near to which she is moored.

She is of 158 tons measurement, having one mast secured with iron rigging, which is preferred, as presenting less surface, and consequently less obstruction, to the rays of light. On the summit of the mast is a globe of 5 or 6 feet diameter, the distinguishing signal of the Trinity House.

She is moored with a spar and bridle, with two anchors, having 75 fathoms of 1½ chain on each of the three legs.

The lantern encircles the mast, by which it is sustained in a steady position. In the daytime it is lowered into a small house, also encircling the mast, and of sufficient size to contain the lantern, with space to pass round it and for ventilation from below. The roof of the lantern projects over the top of the house about 5 inches, so as to make it nearly water-tight.

The lighting apparatus consists of eight 12-inch parabolic reflectors, with Argand lamps, the whole hung on double pinions or gimbles, by which their equilibrium is preserved, and the reflectors retained in a vertical position, whatever may be the motion of the vessel.
The light is revolving, and performs its revolutions once in eight minutes, making successive flashes at intervals of one minute.

The other light-vessels in the Thames are distinguished by different arrangements and colors of their lights.

Their crews are composed of one master, one mate, one carpenter, three lamplighters, and five seamen. Of these there are always allowed to be on shore either the master or mate, one lamplighter, and two seamen, that is, four out of the eleven; but the corporation employ the services of these men, when not on board the light-vessel, in other duties about the establishment at Deptford. The ration allowed to them is equal to 1s. 6d. sterling per diem.

The Trinity board use no other than the best winter-strained sperm-aceti oil, which is obtained by contract after careful inspection. It is kept in immense tanks; and when wanted for supplying the different establishments, is removed in tin tanks covered with basket-work to protect the vessel from injury. These hold each 6 1/2 gallons, being of convenient weight to be carried by one man.

The average price paid in Great Britain for oil is about 6s. sterling per imperial gallon, though it is frequently purchased at 5s. 3d.

**LIGHT-HOUSES OF FRANCE.**

The administration of the light-houses of this kingdom is intrusted, by an ordinance of the King, to a board of officers (''le commission des phares,'') most of whom hold other appointments under the government. Attached to this board is a scientific engineer, who, with numerous assistants and clerks, superintend all the duties of engineer and secretary. This responsible situation has long been held by Mons. L. Fresnel, already respectfully mentioned by me.

By this law of the French government, the light-houses are managed with great judgment and economy; and in these respects the system of France is infinitely superior to that of Great Britain. And I may here remark, that the same vigilance is observed in this country as in England, in watching with unwearied care the burning of the lights and the operation of the machinery. The lantern is never left at night without a keeper, of whom a sufficient number are employed to furnish suitable relief.

In a former part of this report, I have expressed a decided preference to this lens-lighting apparatus, not only because it produces a more brilliant light than any number of reflectors that could be arranged in the same space, but because of the ultimate economy of its use.

A description of the light-house at Barfleur or Gattville, which is of the first class, and quite equal to any in France, will answer in application to all others in the country, all being under the same general superintendence and systematic regulations.

This splendid edifice is situated about two miles from the small seaport town of Barfleur, and stands upon a projecting piece of land, the level of which is only 15 feet above common tides. In very heavy or shore winds with full tides, the surrounding surface is partially covered by the sea; hence the light-house is approached by a stone causeway terminating
with massive parapet walls, protecting a line of compact buildings, forming three sides of a square, and intended for the accommodation of the engineers and keepers. Within the area formed by these buildings the light-house is reared, the whole being on a scale of grandeur, solidity, and beauty, rarely equalled. The blocks of granite are of great size, very carefully hammered, jointed in the most perfect manner, and laid in cement.

The walls of the exterior building are three feet thick. The light-house is, at its base, of square form, 39 feet on each side, having walls 12 feet in thickness, and upon which the circular tower is elevated, being at its base 27 feet in diameter, and gradually tapering to 21 feet.

The walls of the tower are of proportional thickness, yet, notwithstanding every care has been taken by the architect to render the building firm and stable, the vibrations of the summit of the tower in heavy gales, according to the account of the keeper, are remarkable. He represented to me that the lantern moved in such a manner that it was difficult for the keepers to retain their foothold; that the revolutions of the apparatus were sometimes stopped by the binding of the parts caused by the vibrations, and that it became necessary to turn the machinery by hand.

The apex of the tower is in height about 240 feet, and the lantern is reached by a spiral staircase of 367 steps.

The apparatus is of the first order, and composed of sixteen series of lenses, with seven rows of mirrors above and four below. It is revolving, and performs its revolutions once in eight minutes, and flashes at intervals of thirty seconds. The machinery for producing the revolutions is similar to that used in England.

The lantern is lighted with a carbolic or mechanical lamp of four concentric wicks placed within the centre of the apparatus, and a spare one is kept constantly in readiness to be substituted for the one in use, should that one become suddenly extinguished. This inconvenience is, in fact, one of the strongest objections that can be brought against the single lamp with concentric burners for light-houses, as, in the event of the light being extinguished, at least twenty minutes must elapse before another can be lighted up.

Belonging to each of the sets of lens apparatus contracted for in Paris, are three of these lamps, two spare ones to each set, and as these have already arrived in the country, I shall allude no further to them than to remark that, in my opinion, the English hydraulic lamp, manufactured by the Messrs. Wilkins, and brought by me from London, is preferable, from its simplicity of construction and consequent less liability to derangement. It has also four concentric burners, and is adapted to the lens apparatus.

The oil used in this and all the French light-houses, and generally throughout the kingdom for domestic purposes, is of vegetable production, the growth of various parts of France and Belgium. It is extracted from the seed of a species of wild cabbage, called in France "colza," its botanic name, according to Stephenson, *Brassica oleracea colza*.

With a view to witness its cultivation, I took pains to visit St. Morlo, in which vicinity it is extensively produced, and with profitable return. The oil can be afforded at about 90 cents per gallon, and, though
probably little inferior to the best spermaceri, is sufficiently good for all useful purposes.

The immense advantage of possessing a product of this sort within the limits of the United States, by which we should, in case of war, be rendered less dependent on the whale fishery, struck me as so important that I procured and brought with me to this country ten pounds of the seed of the plant. Some of this I distributed immediately after my return, and the remainder I now place at the disposal of the department.

I also procured, at Paris, a pamphlet (the only one to be had) containing a treatise upon the cultivation of the colza. This I have caused to be translated, with the hope that it might be of some benefit.

The exhausted tobacco lands of France and Belgium answer remarkably well for the cultivation of the colza, and it occurred to me that the same description of land in Virginia and Maryland, where the climate is not unlike that of the north of France, would also be congenial to its growth.

In concluding this report, I have to apologize for having delayed it so long. Uninterrupted occupations, of a character more immediately professional, have hitherto prevented my giving any attention to the subject, and I have now hastily drawn it up while deeply engaged in other duties. Respectfully submitted.

M. C. PERRY,
Captain, United States Navy.

FOG BELLS.

At the request of the late Col. Loammi Baldwin, Captain Joseph Smith of the United States Navy, Dr. Charles T. Jackson, and others, an appropriation was made by Congress, in 1838, for the erection of a fog-bell on White Head, at the entrance of Penobscot bay, to be rung by power obtained from the tide, on a plan arranged by Andrew Morse, jr., and explained by him to the above-named gentlemen. This bell was erected and has been in successful operation for two seasons past. The principles on which it is constructed and operates, will be understood from the following extracts from the report of commissioners who were requested by the Treasury Department to examine the machinery, and report their opinion of its "value and fitness for the purposes intended."

[Extracts.]

The power which rings the bell is obtained by the rise and fall of the tide and the "swells" which at that place are constant and unceasing. One end of a large stick of timber, near 30 feet in length, projects out upon the water, the other end being confined by braces and chains to the middle of another stout timber, some 20 feet long, which lies along the shore, hinged at each end to a projecting rock; both together forming a T. From their point of junction a small timber rises vertically,
to the height of 18 or 20 feet, being well braced to its position; to the upper part of this mast is attached a chain, which, with a continuous rod of iron, extends up to the bell-house, a distance of about 140 feet. This chain receives from the vibrations of the outer end of the long timber, and a "take up weight" in the bell-house, a constant reciprocating motion, which, acting upon the machinery in the bell-house, winds up the heavy weight of about 2,000 pounds, that drives both the regulating and striking part of the apparatus. The peculiar arrangement of wheels, &c., called the "maintaining power," which enables the weight to perform these two offices at the same time, without either interfering with the operation of the other, is an ingenious invention, yet quite simple, and not likely to get out of order. Ordinarily the action of the float greatly exceeds what is required to wind up the weight; and there is an arrangement by which, when the weight is wound up, the connecting wheels are thrown out of gear, leaving the float to act without effect, until the weight descends to a certain point, when the connection is formed again. The bell is struck four times a minute by hammers weighing about 15 pounds, and the blow appears to be as heavy as the bell will bear with safety. The force of the blow may be increased or diminished at pleasure.

The desideratum seems to have been to arrive at some mode of ringing fog bells, which should insure certainty and constancy. That which depends upon the personal attention of the light-keeper, as experience has shown, can never be relied on. Dense fogs often arise suddenly, when the keeper is absent, or during the night when the bell is silent, and the keeper asleep; and mariners relying upon hearing a bell, where there is one, often fall into danger, and meet with disaster from that very reliance. At some seasons of the year, when fogs are frequent, or when, as sometimes, they obscure the lights even at the distance of a few rods, for several days and nights in succession, safety to the mariner, so far as fog-bells are concerned, is to be found only in the sleepless vigilance of the keeper, which is not to be looked for without the expense of two or three more keepers, nor even then.

After carefully examining Mr. Morse's machinery, and witnessing its operation as applied at White Head, from the best consideration we are able to give it, the undersigned concur in the opinion that the object sought has been fully and successfully accomplished by it, and that for such purpose it is a valuable invention, which promises to be, in many places, an important auxiliary to the means of protecting vessels from the disasters which, on our rocky and rugged coasts, so often befall them.

Signed by

JOHN RUGGLES.
SULLIVAN DWIGHT.

The following testimonials from experienced shipmasters, and others, show the importance attached by them to this improvement, and justify the inventor in calling the attention of the public to it, in view of its bearing on the interests of commerce and humanity:
SIR: Having been repeatedly guided in my course by the sound of your "Perpetual Fog-Bell," now in successful operation at White Head on the coast of Maine, and being fully satisfied that your invention is invaluable to the commercial interest generally, I can cheerfully give my testimony in favor of it, and recommend the same in the highest terms of approbation to that portion of the public who feel an interest in the preservation of life and property at sea. By the assistance of your bell placed upon all the dangerous points of our coast, the mariner would be guided with unerring certainty in his course through the most dense fogs, and not be obliged, as he now frequently is, to lay for many days waiting for the fog to clear away, and many times to the imminent peril of those subjected to this inconvenience. As your invention has stood the test of the sea unharmed while in its most violent state of agitation, with the float, by which the power to ring the bell is obtained, boldly exposed to its full force, I cannot but feel the fullest assurance of its success to resist the force where you shall think it practicable to apply it. With the sincere wish for the success which your valuable invention merits, I subscribe myself, respectfully, &c.,

THOMAS HOWES,
Commander of steamer North America.

To Andrew Morse, jr.

To whom it may concern:

It gives me great pleasure to recommend to the favorable consideration of all persons interested in the navigation of vessels upon the British and American coasts, the fog-bell lately invented and put into perfect operation by Mr. Andrew Morse, jr., the bearer herof. I consider this bell as the only completely successful attempt which has ever been made to navigate our waters in dense fogs. I am master of the steamboat Bangor, which plies between Boston and Bangor, by way of Portland. For the two last seasons I have been able to run my boat into and out of Penobscot bay in the thick fogs which frequently occur, by the aid of one of Mr. Morse's fog-bells, situate on White Head, a promontory in the mouth of the bay. Without the assistance of this bell, I should have been compelled very frequently to have stopped on my passage. The bell on White Head is placed in an exposed situation. It nevertheless has withstood the action of the tides and the wind, and is still in perfect order. I most sincerely hope that these bells will be placed all along this dangerous coast, for the protection of our commerce and the lives of our mariners. I add, most cheerfully, that Mr. Morse is a gentleman of acknowledged genius, and deserves much praise for this and other valuable mechanical improvements, which he has introduced within a few years past, among his countrymen.

Very respectfully,

S. H. HOWES,
Captain of steamer Bangor.
U. S. Revenue-Cutter Morris,

Portland Harbor, December 9, 1840.

Sir: Having had occasion to visit White Head, at the entrance of Penobscot bay, as much as twice a month during the last year, and observing the operation of your fog-bell machinery, which has stood the test of all the heavy gales and sea we have had upon the coast, and now remains in perfect order, my officers and myself duly appreciate the usefulness of your invention, and you have my sincere wishes that you may reap the reward and receive the credit your ingenuity so well deserves. To all persons navigating our coast, owing to the great prevalence of dense fogs and the uncertainty of soundings, the advantage of such bells, as a guide, must be of incalculable benefit. In approaching this bell in thick fogs, it has been heard by all on board much more distinctly, and at a greater distance, than any other bell upon the coast, although of a much less weight.

Yours, respectfully,

GREEN WALDEN, Captain.

To Mr. Andrew Morse, jr.

WHITE HEAD, St. GEORGE,

December 12, 1840.

To the public: About the 1st of June last, I received an appointment to take charge, as keeper, of the light-house and fog-bell at White Head, in place of Marshall’s Point light-house. I have since that time had charge of the bell machinery established by Mr. Morse. The necessity of bells rung in thick foggy weather to coast mariners passing dangerous rocks, points, and shoals, also in gaining channels in such obscured times, not only in saving property but life, is known and experienced by most seamen.

This arrangement, since I have had the charge of it, has been perfectly successful. The float from which the power is obtained, has stood several extraordinary times uninjured; the machinery that operates the bell hammer is well adapted, and has worked finely, and the blow appears as heavy as the bell will bear with safety.

From what experience I have had of the sea, and the high recommendation that a great number of pilots and shipmasters have given the bell, (when visiting it,) stating their peculiar situation, and the assistance that the sound of the bell had been to them, I consider it invaluable, and highly important to have others established on the dangerous points of our coast, and sincerely hope that Mr. Morse shall receive that pecuniary advantage, as well as approbation for so valuable an invention, he so richly deserves.

WILLIAM PERRY, Jr.,

Keeper of the light-house and fog-bell at White Head, St. George, Maine.
JOINT RESOLUTION making it the duty of the Attorney General to examine into the titles of the lands or sites for the purpose of erecting thereon armories and other public works and buildings, and for other purposes.—(Statutes at Large, vol. 5, p. 468.)

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be the duty of the Attorney General of the United States to examine into the titles of all the lands or sites which have been purchased by the United States for the purpose of erecting thereon armories, arsenals, forts, fortifications, navy yards, custom-houses, light-houses, or other public buildings of any kind whatever, and report his opinion as to the validity of the title in each case to the President of the United States.

Resolved, That it shall be the duty of all the officers of the United States having any of the title papers to the property aforesaid in their possession to furnish them forthwith to the Attorney General, to aid him in the investigation aforesaid.

Resolved, That no public money shall be expended upon any site or land hereafter to be purchased by the United States for the purposes aforesaid, until the written opinion of the Attorney General shall be had in favor of the validity of the title, and also the consent of the legislature of the State in which the land or site may be shall be given to said purchaser.

Resolved, That it shall be the duty of the district attorneys of the United States, upon the application of the Attorney General, to furnish any assistance or information in their power in relation to the titles of the public property aforesaid lying within their respective districts.

Resolved, That it shall be the duty of the secretaries of the executive departments, upon the application of the Attorney General, to procure any additional evidence of title which he may deem necessary, and which may not be in the possession of the officers of Government; the expense of procuring which to be paid out of the appropriations made for the contingencies of the departments respectively.

Resolved, That it shall be the duty of the secretaries of the executive departments, respectively, under whose direction any lands for the purposes aforesaid may have been purchased, and over which the United States do not possess jurisdiction, to apply to the legislatures of the States in which the lands are situated for a cession of jurisdiction; and in case of refusal, to report the same to Congress at the commencement of the next session thereafter.

Approved September 11, 1841.

Treasu ry Department,
Fifth Auditor's Office, December 28, 1841.

SIR: In my letter to the Committee on Commerce of the 14th of December, 1840, they were informed that a workman had been sent from France, at the request of this office, by Mr. Lepaute, the manufacturer of the lenticular apparatus, for the purpose of fitting up in the
best manner two sets of lenticular apparatus in our two light-houses at Navesink, near Sandy Hook, and that it was expected the work would be completed before the close of the last year. In consequence of the inclemency of the weather, however, this work was not completed and both lights in operation before the month of March of the present year.

While the light of one tower was extinguished, and the work of putting up the lenses was in progress, a temporary light was erected and used of the same character; and while the work of the second tower was in progress, the character of the temporary light was changed to suit the occasion, (the one being a stationary and the other a revolving light;) so that the character and appearance of the original lights were preserved, and vessels coming in from sea could readily recognize them, until both sets of lenses were fitted up and put in operation. The temporary light is still preserved, with all its apparatus, to be used in case of any accident happening to either of the lens lights.

This being our first attempt to use the lenticular apparatus, the expense attending it has been greater than it would be in a similar case hereafter. The expense of a workman from France, who, coming to this country late in the season, was obliged to prosecute his work in the short days of winter, many of which were too inclement for him and those associated with him to work, the cost of a lantern made under his direction amounting to nearly thrice as much as one can now be made for, and many other expenses incurred at his suggestion can be avoided in future, if it be thought proper by Congress to authorize any more of the lenses.

Upon a rough estimate of the cost of these two sets of lenticular apparatus, of the first and second order, and putting them up upon two light-houses already built, it appears to be between $23,000 and $24,000.

The cost of these lenses, however, is nothing compared to the beauty and excellence of the light they afford. They appear to be the perfection of apparatus for light-house purposes, having in view only the superiority of the light, which is reported by the pilots to be seen in clear weather a distance of forty miles. It was my intention to have had the distance accurately ascertained by means of one of the revenue cutters, but I have not yet had an opportunity to do so. There are some drawbacks, however, in relation to their management, which would render them unfit for use in the United States upon a large scale, there being but one lamp which supplies all the light, with three or four concentric wicks, and this lamp, made upon the carcel principle, is very apt to get out of order, and the light become extinguished, if the keeper be not an intelligent mechanic, and capable at all times of making the necessary repairs.

We have been so fortunate as to obtain such a keeper at Navesink, a man who can make every part of the machinery, both of the lamp and the clock-work, and apply it in case of necessity without the least delay. and he is a man, moreover, who appears to take a pride in doing his duty in the best and most satisfactory manner. He has attached to him three assistants, taken from the class of seafaring men, who watch alternately every two hours through each night, and being near the city of New York, with which he can communicate in a few hours, he can always obtain men of a suitable character as assistants, and also all necessary materials for making every part of the machinery and keeping it in use.
There is not a single keeper, out of about two hundred and forty, in charge of the reflector lights, so far as my knowledge extends, who is capable of taking charge of and conducting a lens light properly; and there are very few in our country who are capable and would be willing to receive the inconsiderable sum for their services which we give Mr. Lopez, the present keeper at the Navesink, viz: $600 for both lighthouses. It would, therefore, only be in the vicinity of large towns that we should have it in our power to obtain suitable keepers, and at the same time proper assistants, and materials with which to repair the machinery, and of course it could only be in the vicinity of those towns that it would be advisable to employ the lenticular apparatus.

The consumption of oil in the two lenticular light-houses has been upon an average three gallons a night, whilst the consumption of thirty-one Argand lamps, previously used, was about the same quantity, being thirty-two gallons per lamp. The light from the lenses, however, is unquestionably better, but in what precise degree has not been ascertained.

I am desirous at this time to obtain one more set of lenticular apparatus, and that of the third order, to be fixed on the inward light in Boston bay, called the Long Island Head light; the outward light being already well fitted up with new twenty-one-inch reflectors, as a revolving light, in a superior manner. The light proposed, being near Boston, could be examined from time to time by scientific men, and its relative advantages ascertained. It is possible, also, that an improvement may be made in the lamp, which, at present, is the chief objection to the use of the lenses.

The cost of a set of lenses of the third order, with fixed lights, such as I desire, is set down by Mr. Lepaute, the manufacturer in France, at 9,000 francs, or about $1,800, which, with a lantern to be made at Boston, freight, &c., would amount to about $4,500; and the appropriation of this sum for this purpose is respectfully recommended.

In the course of the past summer and autumn, I have caused several of our principal sea lights to be refitted with the improved lantern, containing large plate glass, and with the improved reflector, made in moulds or dies, of the size of twenty-one inches diameter. The White Island, (one of the Isle of Shoals,) Thatcher's Island, (two lights,) in Massachusetts; Cape Henry, at the entrance of the Chesapeake bay; and Tybee light, at Savannah, Georgia, have been thus refitted.

The Scituate light, of a smaller class, and containing two lanterns, has been refitted with large plate glass and fourteen-inch reflectors, as have also the light-houses at Old Point Comfort and New Point Comfort, in the Chesapeake bay.

The two light-houses at Chatham, Massachusetts, for rebuilding which an appropriation was asked, but not made, during the two last regular sessions of Congress, being entirely unfit for use, were taken down and rebuilt at an expense of $6,750, out of the general annual appropriation for the present year. They were fitted up upon the improved plan, with fourteen-inch reflectors.

The light afforded by the improved reflector and lantern, the last of which, having but few sash, presents but a small impediment to the light,
is spoken of with high commendation by masters of ships and pilots, who have had an opportunity of seeing it.

I was also under the necessity of building a new floating light for the Wolf-trap shoal, in the Chesapeake bay, to take the place of one unfit for service, at an expense of $9,015, out of the same appropriation.

It is my purpose, as the old lanterns, lamps, and reflectors become unfit for use, to supply their places with the improved kind, of suitable size, so that in process of time the whole establishment will undergo this desirable alteration.

Since the contract with Messrs. Morgan & Co., for supplying the lighthouses with oil, &c., was dissolved, I have directed the collector and superintendent of lighthouses at Boston to advertise, early in March of each year, for all the oil, both winter and summer, as well as other articles, required for the lighthouses during the year, from Maine to North Carolina, inclusive, (excepting the New York district,*) and have given the contract to the person making the lowest offer; the oil and all the other articles to be of the best quality, and to be tested before they were received. As there is no infallible test of the quality of oil, except by burning it, that test was applied to each parcel by the custom-house officers, before it was received. The oil thus obtained has been found to be of the best quality, and no excuse for the keepers is now admitted for keeping bad lights.

The oil for the lakes is obtained in the same manner. On obtaining the oil, a suitable vessel has been chartered for conveying it, and all other articles necessary for lighting and repairing the lamps, to the lighthouses, with orders to the captain to deliver at each lighthouse 35 gallons for each lamp, two-thirds summer and the other third winter oil, together with the necessary number of tube-glasses, wicks, &c., being one year's consumption; and also to cause all necessary repairs to be made to the lighting apparatus, oil cans, &c., and to substitute new lamps and reflectors where necessary, and with which he is provided.

For the southern lighthouses (viz: from South Carolina to Louisiana, inclusive) the oil has been obtained and forwarded in the same manner, but at a different period of the year, (viz: in October,) by which time the vessel has performed her eastern tour of duty, and is prepared for the southern. The captain of the vessel is required to produce the receipts of the keepers for all the articles delivered, and to report the condition in which he found and left each light-house, as well as the conduct of the keeper.

The supply of oil for the present year, (1841,) for the eastern district, was obtained at $1 for the winter and 88 2/3 cents per gallon for the spring oil; and for the southern district it was obtained at 98 cents for the winter and 86 cents per gallon for the spring oil. This, it will be perceived, was much lower in both instances than the market price. The price, however, fluctuates in such a manner as to render it unsafe to rely upon these prices, and I have, therefore, in my general estimate for the year 1842 rated the winter oil at $1 10, and the spring or summer at $1 a gallon.

* New York being one of the best oil markets, the collector was directed to supply his light-houses from thence.
The expense of maintaining the light-house establishment, consisting of 256 light-houses, thirty floating lights, from thirty to forty beacons without light, and nearly one thousand buoys, is very considerable, notwithstanding the utmost economy has been used in all cases of expenditure. The light-houses, for the most part, are necessarily placed near the water in low situations, and, although at first no danger was apprehended from the water, yet experience has shown that the water is constantly, in a more or less degree, encroaching upon the land, and in a few years it has been found that light-houses, which were considered in no danger when built, must either be removed to situations more secure, or have breakwaters put around them at an expense as great as that incurred in building. Beacons are always placed on some dangerous shoal, in the water, are built at great expense, and being exposed to the fury of storms and a raging sea, are frequently demolished, requiring a heavy expenditure to replace them. Buoys are replaced at great expense also, being frequently driven from their moorings, by storms, and lost.

The expense of the establishment, therefore, depends so much upon the weather throughout the year, that the estimate presented to Congress at the commencement of each regular session must necessarily be imperfect. The only guide in forming it, within the reach of this office, is the actual expense of the establishment for the preceding year, derived from the accounts made up to the 1st of July of that year, being the latest period to which the accounts are rendered and settled. The expenses of the entire establishment, for the last year, were as follows:

For the year 1841, ending 1st July—
For light-houses.......................................................... $348,635 41
For floating lights.................................................. 85,050 58
For beacons, buoys, &c.............................................. 26,136 60

Total................................................................. 459,822 59

As the expenses of the establishment vary from year to year, as has been already stated, sometimes exceeding the estimate and appropriation, and at others falling much below them, it has been found necessary to bring the balance of appropriations forward, from time to time, to meet any excess of expenditure for any particular year. Were this course not adopted, the establishment could not be kept up; many of the houses would be demolished, and the light in others extinguished for the want of means to protect the one and repair the apparatus of the other.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

Hon. John P. Kennedy,
Chairman Committee on Commerce, Ho. of Reps.
Treasury Department,
Fifth Auditor's Office, April 21, 1842.

SIR: Having caused the complaint of J. W. P. Lewis, in relation to our light-house establishment, to be laid before the Marine Society at Boston, and asked their opinion whether or not there are too many lights on the Eastern coast, and whether they could be easily distinguished one from another, and also as to the condition and management of the establishment, I have now the honor to enclose a copy of their answer, which goes to prove that there are not too many lights, and "that the lights generally on the American coast have been much improved, and are in a better condition now than they have ever been before."

Mr. J. W. P. Lewis, in his letter to the honorable Mr. Winthrop, having stated that the reflector invented by his uncle, Winslow Lewis, did not even approximate towards the truth—meaning a parabola—the latter gentleman employed Mr. R. H. Eddy, a gentleman of science, to examine his reflector, and give him his opinion, in writing, on the subject. This opinion Mr. Lewis has transmitted to me, as confirming opinions of scientific gentlemen heretofore given, as to the true character of Mr. Lewis's reflector. A copy of this opinion I have the honor to transmit herewith to the committee.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

Hon. John P. Kennedy,
Chairman Committee on Commerce, Ho. of Reps.

---

Treasury Department,
Fifth Auditor's Office, April 27, 1842.

SIR: Having requested the superintendent of light-houses at Portland, Maine, as well as the Marine Society of Boston, to inquire and inform me whether there were not too many light-houses on the coast of Maine, and if not, whether they were properly distinguished from each other, I have just received his answer, of which I have the honor to enclose a copy. This paper, with that recently sent to the committee, from the Marine Society at Boston, will afford much useful information to the committee, and to the House of Representatives generally.

I take this occasion, also, to transmit the copy of a letter lately received from Captain Sturgis, of the revenue cutter on the Boston station, whose testimony in regard to the light-houses, from his frequent examinations of them in Massachusetts, is entitled to high respect.

The two Plymouth light-houses, of which Captain Sturgis speaks, were built of wood many years ago, and are now in so decayed a state as to be unworthy of repair. For several years past, I have recommended to the Committee on Commerce to make a special appropriation of $7,000, to enable me to rebuild them in a permanent manner, of bricks or
stone. I am much afraid they will fall to the ground in the course of the summer.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

Hon. John P. Kennedy,
Chairman Committee on Commerce, Ho. of Reps.

Treasury Department, March 8, 1842.

Sir: I have the honor of transmitting herewith, in reply to the resolution of the House of February 18, concerning the expenditures for light-houses, the report of the Fifth Auditor, embracing a statement of the amount annually expended from 1st of July, 1816, to 1st July, 1841. I am, respectfully, your obedient servant,

W. FORWARD,
Secretary of the Treasury.

Hon. J. C. Clark,
Committee on Commerce, Ho. of Reps.

Treasury Department,
Fifth Auditor’s Office, March 7, 1842.

Sir: I have had the honor to receive the letter of the Hon. John C. Clark, on behalf of the Committee on Commerce, of the 18th ultimo, with the resolution of the House of Representatives it enclosed, in relation to the light-house establishment, which you referred to me.

On the subject of the expenditures of the establishment, I have the honor to enclose a tabular statement, showing the expenses of each year, from 1st July, 1816, to the 1st July, 1841, in repairing and rebuilding light-houses and light-boats, refitting light-houses with improved lanterns, lamps, and reflectors, &c., in one column; in oil, repairing apparatus, &c., in another column; in building light-houses, light-boats, and beacons, in a third column, and the total expense in a fourth column. The expenses have been calculated from July to July, in each year, because our estimates to be laid before Congress in each year are made up in September or October, and are predicated upon the actual expenses of the year preceding; and we have not the accounts rendered and settled to a later period than 1st July, or rather, 30th June, which show those expenses.

For the last four or five years the expenses of the establishment have increased considerably, in consequence, principally, of the great increase in the number of light-houses, but in some degree of the large number I have caused to be fitted up with the improved lanterns and with improved reflectors, models of which I obtained from England within the above period. The old lanteros, containing glass not larger than 8 by 10 or 10 by 12, presented so much sash, and that very thick, as to obstruct
the light and impair its usefulness in a great degree. From many of
the light-houses on the seaboard, from Boston to Savannah, therefore,
they have been removed, and new lanterns substituted, calculated to con-
tain panes of glass 24 by 20 inches, and they have been fitted up anew
with lamps and 21-inch reflectors, made on a die or mould, as manufac-
tured and used in England, and plated in the best manner. The lights,
thus improved, we have satisfactory evidence, have been seen, or at least
some of them, 35 miles.

The models of reflectors, 21 inches diameter, with lamps obtained in
England, cost $150 each, and those made in the same manner at Boston,
and plated with 16 ounces of silver, and highly polished, have been ob-
tained and fitted up in many of our light-houses at a cost of $80 only.

In consequence of the embarrassed state of the Treasury, I shall for-
bear, during the present year, to place any of the new improved lanterns
and reflectors on any of the light-houses on which the old ones will, in
any manner, answer the purpose intended, except it be the Charleston
light, which being a very important one, and the lantern and lamps and
reflectors very old and decayed, it is my purpose to have refitted this
spring.

For the information of the Committee on Commerce, it is proper to
state, what was recently made known to the Committee on Retrench-
ment, that in England a board of twenty-one active members and ten
honorary members, called the Trinity Board, with numerous persons
under them, is employed principally in the care and management of their
light-house establishment, which, in 1834, consisted of 42 light-houses
and 13 floating lights, as stated in a report made to the House of Com-
mons by a committee of its members. The average expense of these
light-houses and light-vessels, according to a report made by the board
to the House of Commons in the year 1837, (now in my possession,) is
as follows:

<table>
<thead>
<tr>
<th>Light-houses</th>
<th>Average Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>$2,610 each</td>
</tr>
<tr>
<td>13 floating</td>
<td>$8,381 do.</td>
</tr>
</tbody>
</table>

For the year ending 30th June, 1837, the light-houses and floating
lights of the United States cost as follows:

<table>
<thead>
<tr>
<th>Light-houses</th>
<th>Average Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>212</td>
<td>$1,115 each</td>
</tr>
<tr>
<td>27 floating</td>
<td>$2,391 do.</td>
</tr>
</tbody>
</table>

From this comparison, embracing the expenses of every kind in the
maintenance of the two establishments, the committee will be able to
judge how far it is expedient, in the language of the resolution, to re-
arrange the establishment, or to change the mode of its superintendence.

In a letter I had occasion to address to the Hon. John Davis, of the
Senate, in May, 1838, published with a report of the Committee on
Commerce of the Senate, 2d session, 25th Congress, No. 428, I expressed
my opinion very fully upon this subject. In that letter it was stated;
"I consider the present arrangement for managing the light-house estab-
ishment of the United States the most simple and the most economical
that can be devised, and at the same time sufficiently effectual. But it
is now a mere Treasury arrangement, and ought to be recognized and
established by law. The collectors are designated to act as superin-
tendents, under the direction of this office, without any authority of law, and might refuse to execute the duty, if a control was not held over them by means of their collector's offices. They should be bound by law, or at least such of them as may be designated by this office, in concurrence with that of the Secretary of the Treasury, to act as superintendents of lights, under the direction of this office, with a compensation to be fixed by law." [But to impose this duty on them without compensation would be both unjust and impolitic.]

"It is not known to the public who has the general superintendence of the light-house establishment. It is generally believed to be in the hands of the Secretary of the Treasury, who has, in fact, but little to do with it. I would respectfully propose, therefore, that the name and the style of the office should hereafter be 'the Auditor for the Department of State, and General-Superintendent of the Light-house Establishment.' The powers and duties of the Auditor may remain as fixed by the law of the 3d March, 1817; but those of the light-house establishment ought, in a general way, to be defined by law."

As the committee are required by the resolution, among other things, to inquire into the propriety of equalizing the compensation of the superintendents, light-house keepers, and the keepers of other lights, buoys, &c., it may be proper to say something upon that subject.

For many years past, the superintendents have been allowed 2½ per cent. on their light-house disbursements, and, down to the year 1822, the establishment being inconsiderable, those having the most to disburse did not receive exceeding four or five hundred dollars a year for their services. By a law passed 7th May of that year,* however, the compensation as superintendents was limited to four hundred dollars a year, and, since that time, some four or five, having the largest districts, have received that amount; and the residue, about forty in number, received only from one hundred to two hundred dollars each, per annum. It is not perceived how any cheaper or better mode can be adopted; for, as to equalizing the services and compensation of these officers, situated as the light-houses are, it is altogether impracticable. It is equally impracticable to equalize the pay of the keepers by law, and do justice to them. By the law of the 23d May, 1828,† which was passed upon the recommendation of this office, the Secretary of the Treasury was authorized to allow such compensation to the respective keepers as he should think proper, not exceeding an average of four hundred dollars per annum. Under this law, the advantages and disadvantages of each keeper were taken into view by the Secretary and myself, and the salary of each fixed accordingly, varying from three hundred and fifty to six hundred dollars. No other mode, which has occurred to me, is so well calculated to do justice to the respective keepers.

The salaries of the keepers of floating lights were established by the act of the 26th May, 1824, fixing those at sea at seven hundred dollars, and those in the bays and sounds at five hundred dollars, conformably to which the salaries of the keepers of all floating lights subsequently built have been fixed.

For my opinion on the subject of the lenticular apparatus obtained from France, and fitted up in the two light-houses at the Navesink, near Sandy Hook, and for a detailed statement of the management of the light-house establishment generally, I beg leave to refer the committee to a letter I addressed to them on the 28th December last, and to ask the favor of them to make it a part of this report.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

Hon. WALTER FORWARD,
Secretary of the Treasury.

---

EXPENDITURES—LIGHT-HOUSES, &c.

Letter from the Secretary of the Treasury, transmitting a report of the expenditures of the light-house establishments, &c.

March 19, 1842.—Referred to the Committee on Commerce.

Treasury Department, March 11, 1842.

Sir: I have the honor, herewith, to transmit to the House of Representatives the report of the Fifth Auditor and acting commissioner of the revenue, in regard to the expenditures of the light-house establishments, giving information required by a resolution of the House of Representatives, passed on the 14th ultimo.

I am, very respectfully, your obedient servant,

W. FORWARD,
Secretary of the Treasury.

Hon. JOHN WHITE,
Speaker of the House of Representatives.

---

Treasury Department,
Fifth Auditor's Office, March 10, 1842.

Sir: In answer to the resolution of the House of Representatives of the 14th ultimo, which you referred to me, I herewith enclose the annual returns of the superintendents of light-houses, made up to the close of the years 1840 and 1841, showing the oil, tube-glasses, wicks, and buff-skins, delivered at the light-houses, the consumption during those years, and the quantity and number remaining on hand at the end of each year; showing, also, the number of lamps lit and the number of spare lamps, and generally the quantity of the oil, both winter and summer.

The keepers do not make quarterly returns to this office, but are directed to make them to the respective superintendents, whose duty it is, at the close of the year, to prepare and transmit to this office a return for the whole year.
To these returns I have added a printed list of the light-houses and floating lights, showing some particulars not contained on the returns, which may be interesting to the House of Representatives.

There being no collector or other revenue officer on Lake Michigan, great difficulty has been experienced in having the lights there properly attended to; the compensation of 2½ per cent. on the disbursements, after the light-houses, ten in number, were built, being too inconsiderable to engage the services of a competent person. The Secretary of the Treasury, therefore, upon the recommendation of this office, in September last, determined to allow a salary of $500, in addition to the 2½ per cent., to a person in Chicago to act as superintendent, under the law of 7th August, 1789, and I hope hereafter justice will be done to the lights, though he has been too short a time in office to make the return required at the close of the last year, in a manner as satisfactory as could be required, as will be perceived by the return itself.

With the annual returns I send a list of the beacons, buoys, spindles, and dauphins in the waters of the United States, as authorized by the various laws upon that subject.

Since the contract with Messrs. Charles W. Morgan & Co., for supplying the light-houses with oil, wicks, tube-glasses, buff-skins, &c., and keeping the apparatus in repair, was abrogated in 1839, no contract has been entered into with any person for that purpose, (excepting the lakes,) instead of which, the collector at Boston has been directed, in March and September of each year, to advertise for proposals for all the oil, both winter and summer, as well as all other articles which were necessary for keeping the lights up, and to accept the lowest offer; the oil and every other article to be duly inspected and approved before they were accepted. The oil has not only been tested by the oillometer, but by burning, also, before it was received; and in this way the best oil has been obtained which the market afforded. These things obtained, as well as lamps and reflectors, and parts of lamps with which to make the necessary repairs to the apparatus, a vessel has been chartered, with an experienced captain, to convey them to the light-houses from North Carolina to Maine, in the first instance, (with the exception of New York and Rhode Island, where the collectors supply their own light-houses,) deliver the oil and other articles at each light-house, take the receipts of the respective keepers for them, repair the apparatus, and report the condition of the several light-houses to this office. This service effected, the vessel takes another cargo, in October, from South Carolina to Louisiana, and disposes of it in the same manner, which occupies the vessel an entire year.

For the supply of the lake light-houses for the last two years, the collector at Boston was directed to advertise for proposals to deliver the necessary oil and all other articles, at the expense of the contractor, for a given sum of money per lamp, he to produce the receipts of the keepers for all the articles delivered, as in the case of the light-houses on the Atlantic. There were such general complaints, however, of the indifferent quality of the oil for the last year, that I determined, for the present year's supply, to direct the collector to advertise for the oil and all other necessary articles,

* This is done because the oil market is considered as good as that at Boston.
to test the quality of each article fully, and to forward them, first to Albany, and thence by the canal to Buffalo, where the collector has been directed to charter a suitable vessel to convey them to the light-houses on the upper lakes, under the charge of a person in whom we can con-
dide. For Lakes Ontario and Champlain, the oil will be sent to the superintendents at Rochester and at Plattsburg, to be delivered. These supplies, it is expected, will reach Buffalo and the other places mentioned by the first of April next.

Although the lamps made under the direction of Mr. Winslow Lewis have burners of uniform size and make, and the great majority of our light-houses are fitted up with them, yet there are no two keepers who use the same quantity of oil during the year; some using 26 gallons, and some of them 40 and 42 gallons per lamp. And it is found that all new keepers cause to be consumed more than the old ones. This fact is very striking in the returns of Mr. Starkweather for 1840, and Mr. Mervin for 1841, in the Cleveland district, in the latter of which new keepers generally were employed. So great was the difference, that I felt con-
fident the oil had been purloined and sold, and wrote to Mr. Merwin to investigate the matter and to report to me the fact. His answer was, that he could not discover that any fraud had been committed, but rather thought the increased consumption ought to be ascribed to the ignorance of the keepers of the management of lamps. All the keepers, however, old or new, have it in their power to misapply the oil to some extent, and I know no mode of preventing this; for it would be exceedingly unsafe to limit them to any particular quantity, as they would always plead that limit as an excuse for keeping bad lights. Our chief reliance, therefore, for a strict performance of duty, must be on the good character and standing of the keepers when appointed.

It is proper to state that, for the year 1841, returns have not yet been received from four of the superintendents, and in four other cases the returns have been sent back for correction. The superintendents have been directed to make and to correct these returns and forward them without delay. When received, they shall be copied and sent to you in conclusion of this report.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

Hon. Walter Forward,
Secretary of the Treasury.

APPROPRIATIONS FOR LIGHT-HOUSE ON FLYNN'S KNOLL.

Letter from the Secretary of War, transmitting a report of the amount of money expended of the appropriation made for the erection of a light-house on Flynn's Knoll.

April 20, 1842.—Referred to the Committee on Commerce.

War Department, April 16, 1842.

Sir: Under a resolution of the 12th instant, requiring the Secretary of War to report to the House of Representatives "the amount of money
expended of the appropriation made for the erection of a light-house on Flynn's knoll, for what expended, giving the items of expenditure, and the present state and condition of the work," I respectfully transmit herewith a report of the colonel of Topographical Engineers, containing all the information that can now be furnished by this Department. That part of the resolution requiring "the items of expenditure" has been referred to the Third Auditor, who states that copies of the abstracts and accounts cannot be immediately furnished; they will hereafter be transmitted with a further report.

Very respectfully, your obedient servant,

J. C. SPENCER.

Hon. John White,
Speaker of the House of Representatives.

---

BUREAU OF TOPOGRAPHICAL ENGINEERS,
Washington, April 15, 1842.

Sir: In conformity with a resolution of the House of Representatives of the 12th instant, calling upon the War Department for information in reference "to the amount of money expended of the appropriation made for the erection of a light-house on Flynn's knoll, for what expended, giving the items of expenditure, and the present state and condition of the work," I have the honor to submit the following report:

Until last December, this work was under the direction of the Bureau of the Corps of Engineers, when it was transferred to the direction of this bureau. Since then, nothing has been done but to receive the property and effects of the work.

From the papers which were turned over with the work, I enclose a copy of a letter from Major Smith, of the 9th of January, 1840, giving an account of the destruction of as much of the work as was then erected, by storms. I also enclose a copy of the report of the same officer, going fully into the history of this work, the injuries it had received, and the amount which had been expended upon it.

From an examination of the appropriation and expenditures, it appears that on March 3, 1837, there was appropriated for this work.......................... $200,000 00

Amount drawn from the Treasury.......................... 61,090 74

Leaving an unexpended balance of.................. 138,909 26

This unexpended balance was carried to the surplus fund, in conformity with law, on the 1st of January, 1840.

The amount drawn from the Treasury was.............. $61,090 74

The amount in the hands of the agent at this time is...... 9,500 00

Leaving for the total amount expended on the work...... 51,590 74
That part of the resolution which calls for the "items of expenditure" will have to be answered by the Third Auditor, the accounts in which these are exhibited being in his office. I understand they are very voluminous, and that it will take some considerable time to furnish the information in a manner to meet the demand of the resolution.

Very respectfully, sir, your obedient servant,

J. J. ABERT,
Colonel, Corps Topographical Engineers.

Hon. J. C. SPENCER,
Secretary of War.

GOVERNOR'S ISLAND, NEW YORK,
January 9, 1840.

SIR: The day before yesterday one of our boat's crew informed me a Sandy Hook pilot had told him a part of the work on Flynn's knoll had been carried away, and he had seen the fragments (logs and planks) lying on the beach of Sandy Hook.

Yesterday I went down to Flynn's knoll, and found, on examining the work there, that the greater part had been destroyed, and what had not been destroyed was much shattered. I could not make as particular an examination as I desired in consequence of the risk of approaching the work. The boat I was in was small, and of slight construction, and there was a heavy sea, and a very strong tide running. From such observations as could be made, while rowing around the work, it appeared that the greater injury had been sustained at the eastern and western extremities of the work, viz: the parts that had withstood the gales of August and September last, while they were not connected with each other. The piles driven in October and November last, to connect these parts, and which became the centre of the work, were less injured, although they also had experienced injury, as there appeared to be one row less of them than had been driven. The portions of the eastern and western extremities that curved towards the south were entirely destroyed. On the piles that remained there was no trace of the lattice bracing that had been laid horizontally on the top of the work throughout its whole extent, and the ties cross-laid edgewise were much shattered. The number of piles that remained were not counted, but it is thought they did not exceed a third, or perhaps a fourth, of the whole number that were there in November last.

No opinion could be formed, from the appearance of the work, as to the cause that had produced the injury. To get information on this point, and also to ascertain when the injuries occurred, we went to Sandy Hook to consult the keeper of the light-house. He said there had been a very severe storm, accompanied by an unusually high tide, on the 22d ultimo; and he supposed the heavy sea, raised by the tide, to an unusual height on that occasion, had weakened the framing of the work to such a degree that it was not capable of resisting the effect of another storm of equal violence, with the tide as high as it had been during the pre-
vious storm that happened on the 28th or 29th ultimo; for it was during the latter storm, he said, that the injury had been done. He said that during both these storms the sea was higher than the top of the work; and he supposed that in passing over the work it had carried away the boxes containing ballast that had been placed on the top; and had also carried away the lattice-work, or platform, as he called it.

I will make a more particular examination of the work, and report the result, as soon as I can procure a suitable conveyance for visiting Flynn's knoll. Our steamboats and sloop, which might be used for that purpose, are now locked up in ice at Fort Schuyler.

I am, sir, very respectfully, your obedient servant,

JNO. L. SMITH,
Major, Corps Engineers.

Colonel J. G. TOTTEN,
Chief Engineer, &c., City of Washington.

FLYNN'S KNOLL LIGHT-HOUSE,
Governor's Island, N. Y., October 17, 1840.

SIR: The sums drawn out of the appropriation for the Flynn's Knoll light-house amounted, prior to the 3d of September, 1839, to........................................... $37,590 74
And during the year ending the 30th September, 1840, to................................. 23,500 00

* These sums, added together, make the whole amount on the 3d of September, 1840 .................. $61,090 74

The sums expended on account of Flynn's Knoll light-house amounted, prior to the 30th September, 1839, to................. 42,332 74
And during the year ending the 30th September, 1840, to................................. 8,888 07

These sums, added together, make the whole amount expended on the 30th September, 1840.............................................. 51,220 81

Which amount, deducted from the amount drawn out of the appropriation for that work, leaves, as the amount unexpended, in the hands of the agent........................................... 9,869 93

The annual statement for last year of the progress of the operations for the construction of the Flynn's Knoll light-house, and its condition, explains the circumstances that caused delay in the preparations for and the commencement of the operations, and the difficulties attending their prosecution and retarding their progress. It alludes, also, to the gale of the 16th of August, of last year, and the injury it occasioned to the
works; and, in reference to the latter, intimates the probability that the works would have sustained no injury from the gale, if they had been in a more advanced state.

The works that were injured by the gale of the 16th of August, of last year, were a part of the temporary works intended to afford shelter and facilities to the operations for the construction of the light-house while they were carried on. They were adopted under the conviction of their fitness and peculiar adaptation to the object they were intended to fulfil; and they were recommended, also, by their cheapness, compared with any other works that could be substituted for them; which was important, as they were to be temporary; and by the rapidity and facility with which they could be executed, in consequence of their admitting of the employment of a large force upon them at the same time; which was further important, as it was desirable that they should be completed as soon as practicable. The only objection to them, that they might not be secure against the effect of gales until after they should be completed, was not regarded, as they were to be constructed during a season of the year when gales were not to be expected; and it was thought they would be exposed but a short time; it being intended to finish them without delay, and no doubt being entertained of the practicability of engaging as many workmen as could be employed upon them advantageously.

The success of the plan depended upon the weather being such as it usually was in the spring and summer, and upon the employment of a large force. The weather, so far from being what might have been expected, was boisterous throughout the season, and so much so in the early part of it that the establishment of the site could not be attempted until the last of May. The endeavors to procure workmen were unsuccessful; but as advertisements offering high wages were put forth, and agents, as many as five at one time, were employed to engage them, there was always a hope that the number wanted would be procured, and the operations were therefore begun with a small force, part of which was taken from the works of Fort Schuyler. The force employed at Flynn's knoll never exceeded sixty persons; but for the greater part of the time it was less than the half of that number; and it was sometimes reduced to not more than one-fourth of that number. A force of from two hundred to five hundred persons was deemed to be necessary to construct the temporary works in an effective manner and in due season. The works were in an unfinished state when they were injured by the gale of the 16th of August, of last year. Their capacity for resisting the violence of the gale was therefore far less than it would have been had they been finished. Under these circumstances, it may have been possible that the injury had been done by the force of the wind and waves alone; but there are circumstances, also, that might appear to warrant a doubt, at least, of the correctness of that opinion. The fact is known that, at 5 o'clock in the morning of the 16th of August, the works had suffered no injury from the gale, although it had been raging for five or six hours, and at that time had attained to its greatest degree of violence. This fact is furnished by the overseers and workmen who were on board of the brig Enterprise,
the vessel used as a barrack for the accommodation of the persons employed at Flynn's knoll. She was at anchor, at the distance of two or three hundred feet from the works, until the hour stated, 5 o'clock in the morning, when her cable parted, and she was driven into Raritan bay, at the distance of several miles from the works, before she was brought to anchor again. The gale abated in the course of the day. On examining the works the next day, they were found to be nearly destroyed; but, what was very extraordinary, the greatest injury was sustained by the portions of the work that by their positions should have been sheltered; they being on the leeward and landward side of the works, while comparatively little injury was experienced by the portion of the work on the windward and seaward side, where it had to encounter the first shock of the sea. It was also perceived that the tripod benches were generally in the positions they had occupied before the gale. These tripod benches are of a very fragile structure; they are formed of three scaffold poles, having the larger ends, which are to rest on the bottom, loaded with kentledge, and kept at proper distances by iron braces, and the three smaller ends bolted together, and forming the top of the bench. They are easily moved, and are found to be convenient in forming temporary platforms. It was somewhat remarkable that these benches, with but little strength, and less stability, withstood the gale, as though they had been scarcely disturbed, while parts of the work that had much strength and stability, were entirely destroyed. The facts just stated gave rise to doubts as to whether the injury sustained by the works had been caused by the violence of the gale solely, or in connection with other circumstances that had not transpired; and as to the circumstances that might have operated to produce the injury, there were two conjectures, either of which being established, would have removed all further doubt upon the subject. One of these conjectures was, that a vessel might have been driven through the works during the gale; the other conjecture was, that the brush which formed a part of the structure, and which had been laid between the piles, from the bottom nearly to low-water mark, throughout a large portion of the work, might have floated to the surface, in consequence of having been insufficiently ballasted, or in consequence of the ballast, which consisted of loose stones of moderate size, having by constant and violent agitation gradually slipped through the interstices of the brush, and thus left it free to float to the surface. If a large portion of the brush had floated to the surface, and become entangled with the frame-work that connected the heads of the piles together, forming a mass more or less compact, the power of the wave acting upon such a mass during a gale, would be sufficient to draw out the piles or break them off in a very short time. The effect most likely to happen would be to draw out the piles, as the force of the lateral pressure of the wave would be but limited in comparison with that of its upward pressure, when acting upon the under side of the mass; and this action would, moreover, constantly weaken the resistance, by the vibration of the piles, that would be produced by it, the tendency of which would be to lessen their adhesion to the sand into which they had been driven. If the adhesion should not be overcome in this way, then it is possible the piles might be broken by the force of the lateral pressure, which,
although weaker than the upward pressure, would still be very great, as it would have the advantage of leverage, by its acting against the heads of the piles. The part of the piles at which the fracture would occur, if they were broken by lateral pressure, would probably be at the surface of the sand into which they were driven, as that would be the fulcrum or point of resistance; supposing, as was the case, that the brush which had been laid between the piles had not been in that position long enough to acquire the compactness and solidity it usually attains, in the course of time, by the gradual filling of its interstices with deposits of sand.

If the injury had been occasioned by a vessel, or other floating mass, being impelled against the works by the force of the waves, as referred to in the conjecture first stated, the effect would have been precisely that which was produced. Except a few straggling piles that remained, all the piles that belonged to the parts of the works that were injured were carried away; and when recovered, as nearly all were, it was perceived that, except one of them, which had been drawn out, they were all broken off at their point of contact with the bottom. It was evident from this fact that the injury had been occasioned by lateral pressure; and as the tripod benches, together with the piles belonging to the parts of the work that were not injured, received but comparatively little injury, as has been stated, although they were at the windward, and therefore most exposed side of the works, and some of the piles had brush laid between them, in the same manner as the piles that were carried away, it was also evident that the injury produced had not been occasioned by the force of the waves alone. The prevalent impression, in the first instance, seemed to be that the injury had been occasioned by a vessel having been driven through the works. This impression was strengthened by the recollection of an event of that kind that had occurred the year before. A temporary platform, composed of nine tripod benches placed near to each other in three rows, so as to form a square, and having their tops secured to each other by beams hung to them with chains, with other beams crossing these, and lashed to them, was established upon or very near to the site occupied by the works for the light-house on Flynn's knoll. It was intended to establish a more substantial platform with piles, to be driven from this; and a pile engine, provided for that purpose, was lashed to the beams, in an upright position. In this state, it encountered, on the 12th and 13th of September, 1838, a gale of violence equal to if not greater than that of the gale of the 16th of August, 1839, and of longer duration, and to the surprise of every one, without having experienced the slightest injury. In less than three weeks after the gale it was destroyed, as was some time after ascertained, by being run through by a schooner during a dark night; and so slight was the shock it occasioned to the schooner, that the persons on board of her supposed they had been passing through a collection of drift wood. All the benches had been displaced, and one of them, that had probably become entangled with the stock of the anchor, was found at the distance of a quarter of a mile from the others.

But there were circumstances that seemed to render it altogether improbable that the injury to the works had been caused by a vessel running through them. It must have occurred in daylight, as the works
were known to have been uninjured at 5 o'clock in the morning, and the
gale had abated in the afternoon; and, if it had happened, it is hardly
probable it would have escaped the notice of everyone on board the
vessel. If it had been observed, it would have become public, or, at
all events, would have been known by the pilots, who would have men-
tioned it.

There were circumstances, also, that rendered it improbable that the
injuries had been occasioned by the brush escaping from the ballast that
was intended to keep it at the bottom, and becoming entangled with the ra-
ming of the heads of the piles, so as to form a raft or mass more or less
compact at the surface. In such a case, it would appear to be almost
certain that the upward pressure of the force of the waves, aided by the
buoyancy of the piles, would be more likely to draw them out of the
land, than that the lateral pressure would cause them to break off; and
especially as the upward pressure would have far less resistance to over-
come, since it would be effective upon single piles, or row of piles, in
succession, while the lateral pressure could be effective only after it had
overcome the collective resistance of the whole mass. As long as the
bracing of the heads of the piles remained firm, the escape of the brush
would be but to a limited extent, and the force of the waves, either by
upward or lateral pressure, would be most effective. But although this
would be favorable to the effect of the upward pressure in drawing out
the piles, it would be unfavorable to the effect of the lateral pressure
in breaking them. The bending of the piles before breaking would be
resisted by the framing or bracing while it remained firm; and when
this resistance should be overcome by the destruction of the framing,
the effect would be the escape of the brush which had been retained by
the framing, and the consequent reduction of the power of the lateral
pressure by the absence of the greater portion of the means whereby its
effect was to be produced.

The facts relative to the injury sustained by the works of Flynn's
knoll during the gale of the 16th of August, of last year, and the re-
marks upon them, which are set forth in the foregoing statement, being
matters connected with the subject of the light-house, and such as it
may be proper to preserve in the files of the Engineer department, are
introduced in this report, as they were not included in the annual report
of last year, where the record of them would have been more appropriate.

The works remained in this shattered state, in which they had been
left by the gale, until the beginning of October. The repairing of them,
with some slight additional work deemed necessary to afford further
security, were completed in November. The parts of the work carried
away by the gale were not renewed, the repairs being confined to the
parts that remained after the gale, and the additional work being what
was required to connect those parts.

In making these repairs, no pains or expenses were spared to render
the work capable of resisting, during the approaching winter, the shocks
of violent gales and of drifting ice that were to be expected. Notwith-
standing these precautions, the work was nearly destroyed by a violent
gale that happened near the close of December, during which the gen-
eral level of the sea was said to have been higher than had been known
for a number of years. In a subsequent gale, about the close of last January, all that remained of the work above the water line was destroyed. On examining the site in March last, it was discovered, by means of a sounding rod, that there was brush at the bottom, covered with ballast, and apparently at the same level as that at which it had been laid in the preceding November. It was also discovered that the soundings in the vicinity of the site indicated less depths than those that had been taken at the same places in November; and it was therefore judged that there had been an accumulation of sand in those places. The site has not been examined since March last.

Respectfully submitted,

JNO. L. SMITH,
Major, Corps Engineers.

Colonel J. G. TOTTEN, Chief Engineer, &c.

Treasury Department,
Fifth Auditor's Office, April 30, 1842.

Gentlemen: I observe by a speech made by a member of the House of Representatives, reported in the Intelligencer of this morning, in advocating a transfer of the general superintendence of the light-house establishment from this office, by which it has been conducted for the last twenty-two years, to the Engineer department, that he has been misled into many errors, which I feel it my duty to correct, not only in vindication of my own character, but in justice to the public service. They may be enumerated under the following heads, viz:

1st. He states that the large amount ($195,357) contained in the estimate for repairs is, under the present organization, exclusively controlled by the Fifth Auditor, who can expend it where he pleases, and can apply it to any part of the coast—to Massachusetts, to New York, the Chesapeake, or to Florida. It is hardly necessary to say that the Fifth Auditor, in disbursing this money, must be governed by the wants of the service, let it be either in Florida or Maine; and if no repairs be necessary on any part of the coast or lakes, not one dollar would be expended, but would remain in the Treasury.

2d. He asserts "that the reason so large a sum is required for repairs, is, that the light-houses, as originally constructed, are so entirely unfit to withstand the elements, and erected upon plans so entirely at variance with scientific skill, that it requires a vast amount annually to keep them in anything like habitable order." Now, so far from this being the fact, all the light-houses that I have caused to be built were planned by men perfectly acquainted with the subject, and consist generally of four classes, viz: the largest class are sixty-five feet high, diameter twenty-five feet at base, graduated to twelve feet at the top; the walls five feet at base, graduated to two feet at top; deck fourteen feet; lantern sufficient to contain twenty-one lights, fourteen by twelve inches. The second class are fifty feet high, twenty-two feet diameter at base, eleven feet at the top, deck thirteen and a half feet; walls four feet thick at base, two
feet at top; lantern sufficient to contain twenty-one lights, thirteen by twelve, in each octagon. The third class is forty feet high, twenty feet diameter at base, ten feet at top, deck eleven and a half feet; walls three feet six inches thick at the base, twenty-two inches at the top; lantern sufficient diameter and height to contain eighteen lights, twelve by eleven, in each octagon. The fourth class is thirty feet high, eighteen feet diameter at the base, nine feet at the top, deck ten and a half feet; walls three feet thick at the base, graduated to twenty inches at the top; lantern sufficient diameter and height to contain eighteen lights, twelve by ten, in each octagon. We have sometimes built beacon-lights from fifteen to twenty-five feet high, but they are seldom adopted. A particular description, in each case, is given in the advertisements for proposals to erect the buildings. They have been built of brick or stone.

Experience has shown that a light-house higher than sixty-five feet, in all our Southern country, where the coast is low, would be entirely useless, as, during the summer months particularly, a haze or mist is found to arise from the ground and float in the air at the distance of eighty or ninety feet; and by having a light-house sixty-five feet, with a lantern ten feet, the light appears below the mist, and is seen with its natural brilliancy at a great distance at sea; whereas, if the tower was carried one hundred feet high, or more, the light would be entirely obscured. On the highlands of Cape Cod, and at Gay Head, the light-houses, which were built of the first class, had to be taken down fifteen feet each, in order to avoid the mist, and present a good light.

The light-houses built according to the above plans do not require repair because they are badly built, but because, to make them at all useful, they must be placed on prominent points near the water; and although, when built, no danger is apprehended from the water, yet, contrary to all reasonable calculation, the violent storms, which almost every season visit our seaboard, force the water upon their sites, threatening to undermine the buildings, so as to render it necessary, frequently, to put breakwaters around them, or remove them, at an expense very little less than the first cost. If they were built of adamant, the effect would be the same; so that the honorable member is entirely mistaken in supposing that it is owing to the manner in which the houses are built. I have visited a large number of those houses myself, from Boston to New York, and thence into the Delaware and Chesapeake bays, and I pronounce the buildings generally well made.

3d. What is said concerning the reports of the officers of the Navy, who were appointed to examine the light-houses in 1838, I shall pass over, as these reports have been before Congress and the public for several years, with the single remark, that I regret to perceive the desire to impugn the management of the establishment unjustly, from the fact that the same report from which is quoted Lieutenant Manning's remark, "eight out of nine keepers complained of their oil being thick, and burning badly," contained my remarks correcting this gentleman's errors in regard to the oil, which are not noticed by the speaker. The expressions used by Lieutenant Manning opposite each light-house, where he mentioned oil, were, "oil in the winter complained of as bad." This he did because the oil congealed in winter; he having fallen into the
common error of believing all oil to be bad that congealed in cold weather. My remarks, in the report, went fully to correct this error; and I now subjoin a copy of the certificate upon this subject, from eight of the most respectable oil dealers at New Bedford, (No. 1,) to which I then referred, going to prove that all oil would congeal when the mercury in Fahrenheit's thermometer descended as low as twenty-four degrees. Whilst on the subject of oil, it is proper to correct an error into which the speaker has been led, and of which he speaks in another place, to wit: that I had directed the collector at New York, by way of testing a quantity of oil which he had then purchased, to burn some of each cask before it was received and paid for. The certificate of the New Bedford merchants, before alluded to, goes to show that different whales produce different qualities of oil; and although the oleometer will show the purity of the oil, it will not show its quality; and there is no other way of ascertaining whether it is good than by burning it. I have, consequently, ordered all the oil to be tested, not only with the oleometer, but by burning it also, before we receive and send it to the light-houses.

The contract with Messrs. Morgan & Co., of which mention is made, was dissolved some years ago, and I have subsequently had all the oil and other articles connected with lighting the light-houses procured by the collector at Boston of the best quality, and sent annually to the different light-houses on the seaboard as well as the lakes.

Whatever may have been the condition of the light-houses, as shown by the Navy officers in the report referred to, the Committee on Commerce are now in possession of reports from all our superintendents, and from Captain Howland, of a subsequent date, calculated to remove any erroneous impressions upon this subject.

4th. The Whale's Back light-house is stated to have been built in 1829, "at a cost of $13,000, and had to be cased over with wood in 1831, at a cost of $6,150, in consequence of the scandalous manner in which the original contractor erected his work, and to prevent the keeper from being drowned out by the sea washing through all the crevices." Now, the truth is that the foundation of this light-house, which was forty-eight feet diameter at the base and forty-four feet at the top, and twenty-two feet high, of very strong stone-work, cost $13,810 33, and the tower which was erected on it cost $6,150—making, altogether, $19,960 33. It was not until 1837 that any sheathing was put around it, and that only upon the part upon which the spray of the sea dashed, the light-house being built upon a rock in the ocean; and this was done for the comfort and health of the keeper, and at the inconsiderable expense of $307 38.

The light-house, though the plan was an excellent one, and if carried fully into effect would have endured for ages, was in one respect infamous built, and that was fatal to the whole structure. The contract provided that the rock on which it was built should be reduced to a perfect level, and that all the bottom stones, to be of the large size, should be bolted to it; instead of which, the then superintendent, whom I shall not name, suffered the contractors to lay the stone upon the uneven surface of the rock, and fill up the crevices with small stones, easily washed out; and the water, once getting access, progressed to under-
mine the work in such a manner that I expected it would have fallen two or three years ago. Congress appropriated $20,000 to put a breakwater around it; but, on getting Colonel Thayer and Mr. Parris, of Boston, to examine the work, they recommended the erection of a new light-house, on the plan of that at Eddystone, alleging that no breakwater could secure the present building. The appropriation was, consequently, not expended. Accordingly, I had a plan and estimate, with a model, prepared by Mr. Parris, and submitted the same to Congress on the 20th December, 1838, and recommended that the necessary sum of $75,000 be appropriated for the purpose of erecting a new and substantial building. No appropriation, however, has been made, and I am in daily expectation of information that the present building has been demolished by the force of the sea.

5th It is stated that the collector at Key West visited the light-house at Cape Florida, after it was burnt by the Indians in 1836, (not 1835,) and found that the walls of the tower, instead of being solid, were hollow from the base upwards, by which fraud about one-half of the bricks and materials required to erect a solid wall were saved, to the benefit of the contractor.

However this may be, every precaution was taken by this office to insure the erection of a substantial building of the first class. The contract entered into by Collector Dearborn, of Boston, with Samuel B. Lincoln, required him to build a tower sixty-five feet high, of solid walls of brick, five feet thick at the base, graduated to two feet at the top; and Mr. Dearborn was directed to appoint a respectable and suitable mechanic to proceed to Cape Florida to oversee the materials and work; and he appointed Noah Humphreys, of Hingham; and, when the work was finished, he certified on the contract as follows:

"CAPE FLORIDA, December 17, 1825.—This is to certify that the light-house and dwelling-house on Cape Florida are finished in a workmanlike manner, agreeably to the within-written contract.

"NOAH HUMPHREYS."

Here, then, is a contract requiring a strong, durable building to be erected, with a man to superintend it of respectable character in his neighborhood, and accustomed to work in brick and mortar, certifying that the work is faithfully done. I know of no better mode of securing fidelity in contractors; for, if the ablest engineer in the country were appointed to superintend the work, there would be an increased expense, without a tithe more of security that the work would be well done; and these remarks may be applied to all the light-houses which have been or will hereafter be built.

6th. Removal of the light-house at Stonington, Connecticut.—From all the information I could obtain, I considered it better to erect a small new building on an adjoining lot, secure from the action of the sea, than to put a breakwater around the old buildings, which, in all probability, would protect them but a few years, and the cost would certainly have been equal to the erection of new buildings. The building serving for
both light-house and dwelling for the keeper was therefore erected, under contract, for $2,840, with an expense of $168 to the overseer of the work—making for the cost of the building $3,008, and for new lantern, fitting up, &c., $1,906—being, altogether, a cost of $4,914. The old buildings and lot are not worth $1,500, as stated, but are valued at about $800. To dispose of the lot, however, requires an act of Congress, and it has not been sold on that account.

7th. The Lynde Point light, or Saybrook, as it is called.—The first wall placed around this light-house was in 1829, and cost not $3,000, as stated, but $380; and in 1831 it was enlarged and repaired, at an additional expense of $825. In the summer of 1840 the superintendent represented the necessity of additional works being put around it, and a contract was entered into, and the work performed for $2,500. It does not appear that this light-house, to be useful, could have been located anywhere else.

8th. The next cause of complaint is, that the beacon on Bowditch’s ledge, one in Manchester harbor, and at Black Rock, were carried away by storms, and had to be rebuilt at considerable expense. This is entirely true; and the cause of all this disaster was submitted to Congress, and special appropriations made to rebuild them, without any censure being cast upon this office. Indeed, no man who had any knowledge of the storms which demolished these beacons, even with the most evil designs, could attach any blame either to the superintendent or contractors who built them. For the information of the member, and all others who may feel an interest in the subject, I subjoin an extract (No. 2) of a letter from the superintendent of our light-houses in Maine, the latter clause of which is as follows: “The officers of the cutter just returned from Mount Desert Rock informed me that they there measured one stone that was thrown out of its place by the sea, and found it 18 feet long, 14 feet wide, and 6 feet thick, weighing about 57 tons.”

9th. The beacon on the Romer.—The committee are already furnished with the facts in regard to the building; and for the location of the beacon they are respectfully referred to a report made to this office by Mr. Hoyt, and laid before Congress by the Secretary of the Navy, (1st Sess. 26th Congress, Doc. No. 167.) and a report by the Secretary of the Treasury to the President, who approved of the location. This latter report and approval are subjoined. (No. 3.)

10th. What is said about the deficient number of lamps at several light-houses on Cape Cod may be met by the observations of Lieut. Carpenter, laid before Congress and published in 1838. Instead of increasing the number, he was for diminishing it in many instances; but, upon the remonstrance of persons interested, no alteration was made, the lights being satisfactory.

Whilst on the subject of the lights, it may be as well to say, what I intended to say in another place, that all our lights on our seaboard, with two or three exceptions, from Boston to Savannah, have, within the last two or three years, been fitted up with lanterns containing large plate glass, and with reflectors made like the English, in moulds, 21 inches in diameter, affording a light which is seen, in clear weather, from 30 to 35 miles. Our bay and sound lights too, though not fitted
up with the improved reflectors, but ate well fitted up with the old, afford a light which can be seen from 10 to 20 miles. According to the official accounts both from the British and French Governments, their best lights are seen no further than ours, and their inferior lights, particularly those in France, are not seen so far.

11th The extravagant cost of the French lenses.—The causes which led to extraordinary expenses in this case have been explained in my letter to the committee of the 28th December last. The cost, however, is not so great by $3,233 42, as is alleged in the speech, it being $26,169 58. It is alleged, too, that the accounts passed this office without demur. The men who furnished this information to the speaker in question ought to have known that this was untrue, as it seems they had access to the custom-house accounts and letters at New York, and among them was one from me to Mr. Hoyt, (complaining of the cost of a lantern made there, which was $3,930, not $5,010, as stated,) and Mr. Hoyt’s answer. These papers are annexed, for the information of the committee. (No. 4.)

The greatest error Mr. Hoyt seems to have committed in putting up these lenses, was the employment of Mons. Chapdelaine, from the store of Messrs. Blunt, as the interpreter of Mons. Bernard, the French artisan, who could speak no English; and I have no doubt that Mr. Chapdelaine was disposed to encourage every sort of expense which could increase the cost. with a view to this very complaint; and nothing can show more clearly the deep-rooted hostility of these men, whom I once before exposed, than this transaction. If any engineer offered to assist the French artist gratuitously, I have no recollection of it. Mr. J. W. P. Lewis applied to me for authority to assist him; but as he could neither speak French nor would work without pay, (for I am pretty sure he asked me five dollars a day,) I referred him to Mr Hoyt, to whom it was necessary to refer everything of this kind, not knowing myself what aid the French artisan might require.

12th. Cutter Rush, purchased as a light-house and buoy tender.—Before the purchase of this vessel from the Secretary of the Treasury, at the inconsiderable sum of $2,819, in May, 1840, we were obliged to pay the pilots of New York, after advertising for proposals, the sum of $2,000 a year, for taking up and mooring the buoys alone—the United States being at all the expense of procuring new ones and repairing old ones. This vessel not only performs the service of taking care of the buoys, but conveys the oil, wick, tube glasses, &c., to the different light-houses, men and materials, with which to make the repairs to the light-houses, and, also, the collector on his tour of inspection. 'She is constantly employed in the summer, at a quarterly expense of $551; and in the winter she is laid up in dock, with one seaman to take care of her. Such a vessel is necessary at New York; and if Congress were to allow me two others, for different stations, the service would be promoted by it.
13th. Expenses of the light-ship off Sandy Hook.

It is stated that the cost of this ship, in 1823, was $17,702 33
Repairs in 1831 .................................................. 6,157 28
Maintenance to 1838, at $6,500 per annum, 15 years .... 97,500 00

121,359 61

Now, the truth is, that she cost, as stated ... $17,702 53
Maintenance from 1823 to 1829, 6 1/4 years .... 28,015 71

40,718 24

Being $3,682 on an average, and not $6,500.

80,641 37

On the completion of the Navesink lights, in 1829, this vessel was directed by law to be transferred to another station, and was transferred.

Another was built and moored off Sandy Hook in 1838, and has since been maintained at a considerable expense, the vessel having broken from her moorings twice or thrice, and lost most of them, which cost several thousand dollars, in addition to heavy expenses for repairs, on those occasions; so that in four years her expenses amounted to $24,849 52. This, however, is a vessel of a large class, being two hundred and fifty tons burden, and requiring the services of nine men besides the captain.

The decay of the first light-vessel built for Carysfort reef was very extraordinary and unaccountable. She was built in New York, by Henry Eckford, under the superintendence of an experienced shipbuilder, and examined from time to time, while building, by the collector, Jonathan Thompson, Esq.; and I saw the vessel myself after her timbers were up, but before she was planked; and every other person who saw her, pronounced her a very superior vessel in every respect. She was sent to her station at Carysfort reef, and in five years she was examined, and found so entirely dry-rotten, in every timber, that a new vessel was found to be necessary to take her place. An appropriation was accordingly made by Congress, and another built. This is also a vessel of two hundred and fifty tons burden, and has been, as she always must be, a very expensive vessel. The whole expense of maintaining this vessel at her station, from the year 1825 to the close of 1841, was seventy-nine thousand nine hundred and fifty-eight dollars and thirty-one cents, being an average of four thousand two hundred and thirty-two dollars per annum. In this sum is included nineteen thousand four hundred dollars for repairs, moorings, and coppering, and one thousand two hundred and eighty dollars for a schooner-rigged tender, with which to supply the ship with provisions, &c., there being no revenue cutter on the station.

There is no way, however, of judging of the economy or extravagance in these cases but by a comparison with those in the service of other countries, and I know of no other country which employs floating lights than Great Britain. Being in possession of a list of the British floating
lights, and the expense of each, for the year 1838, as laid before Parliament, I now proceed to make a comparison of the expenses of them and the American floating lights for the same year.

* * * * * * *

It will be seen that the average expense of the British floating lights for 1838 was $7,660, and that the average expense of the American floating lights, which, in general, are larger than the British, is $2,399 only; and yet I undertake to assert, without the fear of contradiction, that our floating lights are better adapted for the purpose than the British, and that the lights are seen (whilst the Trinity Board state theirs to be seen nine miles only) from ten to fifteen miles. A comparison of the drawings of both nations, which I have in my office, will convince any person of the superior excellence of our plan.

The most remarkable part of the speech is that in which the member asserts that I audit the light-house accounts. Now, it is very well known to almost every person connected with the Government, that I do not act as an auditor in regard to the light-house duties, but ministerially; and that when the accounts are received here, from the different superintendents, they are, if correct, entered in books in my office, and afterwards transmitted, with the vouchers, to the First Auditor, who audits and sends them to the First Comptroller, by whom, after approval, they are sent to the Register, entered on his books, and there filed. They do not return to me.

The assertion that there has never been connected with the Light-house Establishment a single officer or attaché of any kind that could lay the slightest claim to a knowledge of architecture or engineering, nor one capable of selecting and afterwards surveying the site of an intended light-house, is calculated to mislead the public. I have never had, and do not wish to have, an engineer or other attaché, employed by the year at a heavy expense, when it is only occasionally I have had use for one, and on those occasions I have employed, for a moderate sum, men of as much practical knowledge of light-houses and submarine works as any others in the country.

The plans of light-houses, of four classes, before described, were devised many years ago by experienced and practical men, and the plans will speak for themselves; and as to locating light-houses, the proper collector of the customs, always an intelligent man, has been charged to view the ground on which a light-house was to be built, and, with the advice of such retired captains of vessels and pilots as he could call to his aid, determine on the proper spot on which to place the light-house. There can be no better mode devised, in my opinion, for obtaining a proper location. The lights are often necessarily placed in low and marshy situations, to which in time the sea gains access, and renders it necessary to remove the buildings or place breakwaters around them. I have generally preferred the former, as breakwaters cannot be relied upon for security for more than a few years. It must be obvious to every man at all acquainted with our coast, and the storms which prevail upon it, that the annual expenses of protecting and securing the light-houses must always be considerable.

As instances of the insecurity of the lights on the coasts, it is proper
to mention that I have just received a communication from the collector at New London, stating that the light-house at that place, which was built in 1800, upon a rock, now requires protection, the sea having approached it, and loosened several of the foundation stones; and also that the light-house on Sand Key, near Key West, built in 1826, on an island of sand of some acres in extent, is now in danger of being swept off by the action of the sea, and the island with it. I have had a temporary protection put around this last, but unless Congress make an appropriation of $16,000, for which I called more than a year ago, it will be destroyed.

I have, in a preceding part of this letter, shown that our light-vessels, though very expensive, and must always be so, are not more than one-third of the expense annually, including repairs, of the British light-vessels; and having shown, in several communications I have heretofore made to Congress and the Committee on Commerce, that our light-houses do not, on an average, cost half as much as the British or French, so far as we can ascertain the expenses of the latter, it is all that I can do to prove the economy observed in the administration of our light-house department; and as to the efficiency of the lights of both descriptions, it has never been questioned by men who are really interested in it, but, on the contrary, testimony of the highest character, from captains of ships and pilots, and others interested in navigation, has been from time to time received, of the brilliancy of all our lights on the seacoast.

Our light-houses and light-vessels have been the subject of so much misrepresentation, within a few years past, by persons having no immediate interest in their welfare, and particularly at the present session of Congress, and many members have been impressed with erroneous opinions concerning them, that I am induced, respectfully, to ask that the House of Representatives will appoint a committee of its members for the purpose of inspecting them, from Passamaquoddy to the Sabine, or such portion of the coast as they may find it convenient to visit, promising, on my part, either to charter a vessel for their use, or fit up the cutter "Rush" in a suitable manner for the purpose. On their report I am perfectly willing that the present system shall stand or fall.

On the subject of the light-houses which, it has been alleged, have fallen down in consequence of being badly built, I will write to the committee in a few days—it having required, and still requiring, much research to obtain the necessary information, distributed among a mass of papers, covering a period of more than twenty years.

I have the honor to be, gentlemen, your most obedient servant,

S. PLEASONTON.

Hon. JOHN P. KENNEDY, Chairman, &c.

TREASURY DEPARTMENT, January 24, 1840.

SIR: I herewith transmit a copy of a report made by me to the President, relative to the light-house on Robbins's reef, and a beacon on Romer shoal, with which the President concurs.

I am very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

STEPHEN PLEASONTON, Esq.,
Fifth Auditor.
Treasury Department,  
Fifth Auditor’s Office, May 13, 1842.

Sir: I now proceed to notice and explain the various allegations contained in the speech in relation to the light-house establishment, which was reported in the National Intelligencer on the 28th of April last, of a large number of light-houses having fallen down, or been rebuilt, in consequence of their having been badly built originally, viz:

“Frank’s Island light-house, erected in 1820, by Winslow Lewis, at a cost of $85,507 56.”

“To prevent its tumbling down, owing to the settlement of the foundation, it was taken down and rebuilt of the old materials, in 1822 or 1823, at a cost of $9,750.”

The first light-house built on Frank’s island was built by Winslow Lewis, under a contract entered into with Samuel H. Smith, Esq., the commissioner of the revenue, in 1818, and not 1820, as above stated; and Mr. Lewis will doubtless explain the cause of the foundation giving way, and rendering the light-house useless.

Mr. Lewis proposed afterwards, in a letter he addressed to me in December, 1821, to rebuild the light-house on a foundation to be prepared by himself, and which he would insure for a certain number of years, for $9,750. This letter was transmitted to the chairman of the Committee on Commerce, Thomas Newton, Esq., in one from myself, in March, 1822, and the proposition of Mr. Lewis adopted, and the precise sum he asked was appropriated by both Houses of Congress. A contract was accordingly entered into with him, and a new light-house, of the first class, erected at Frank’s island, which has been in use ever since, now 20 years, and will probably endure for ages. A copy of my letter to Mr. Newton (marked A) is subjoined. The letter of Mr. Lewis will doubtless be found on file in the committee room of Commerce.

“Brandywine shoal, erected in 1827 or 1828, by Winslow Lewis, at a cost of $50,000, soon after tumbled down, owing to defective foundation—a total loss.”

This light-house was not built by Winslow Lewis, but by William Strickland, Esq., of Philadelphia, whose plan and estimate had been laid before Congress, approved, and an appropriation made of $29,200. Mr. Strickland was consequently employed to do the work, which was very soon afterwards demolished by the action of the sea.

“Natchez light, erected in 1827, but, being placed on and near the edge of a bluff, was, by a landslide, precipitated to the bottom and destroyed;” cost, $8,428.

This light-house did not fall in consequence of being placed near the edge of a bluff, but was partly destroyed by the tornado, which demolished a large part of the town of Natchez a few years ago, and the residue was taken down at the solicitation of the town. It never was of much use, and it is not intended to put another in its place.

“Bois Blanc Island, Lake Michigan, erected in 1829, at a cost of $4,695; paid for securing foundation, in 1830, $622 91; soon after undermined and destroyed by the sea, and rebuilt in 1888, at a cost of $4,551.”

This light-house, when located, was considered perfectly secure, but
the extraordinary rise of the waters of the lake, in 1836 and 1837, brought the water to its base; and in 1837, for the first time, Mr. Wendell, the superintendent, informed me it was in danger. He was immediately directed to protect it either by a wall or a wharf in front; but before anything could be done in this respect, a storm arose, in December, 1837, and, forcing the water upon the base of the light-house, it was undermined and fell. There was nothing, therefore, expended for protecting it, as erroneously stated above. The case was laid before Congress, and an appropriation made, for rebuilding the light-house, of $5,000, on the 7th of July, 1838, and it was accordingly rebuilt. A letter from this office, dated February 20, 1838, to the Committee on Commerce, of which a copy is annexed, (marked B,) fully explains the subject.

"Sandusky light-house, erected in 1821, at a cost of $4,250; expenses on foundation in 1822, $2,520; rebuilt, owing to its dilapidation and decay, 1838, at a cost of $3,000."

No part of this statement is true. The light-house was erected at a cost of $7,232; the $2,520 mentioned above being a part of that sum. Nothing was ever paid for securing the foundation, nor was it ever rebuilt at all. The light-house now stands in good condition as it was built, 21 years ago.

"Stuyvesant light, Hudson river, erected in 1830, on a pier, at the edge of a meadow, for $4,000."

This light-house, with the pier on which it was built, was swept off by the floating ice in March, 1832, with several of the keeper's family, who were lost. This was not the only damage done in that neighborhood. Mr. Walter Butler, in a letter to the collector, transmitted to this office, states that "we are suffering much at our village, (Stuyvesant.) The prospect is that there will be a great loss of property." The case was submitted to Congress, and an appropriation made of $5,000 for rebuilding the light-house, and it was accordingly rebuilt.

"Thunder Bay, Lake Michigan, (Huron it ought to be,) erected in 1830, at a cost of $4,094; soon afterwards undermined by the sea, and destroyed; since rebuilt; cost unknown."

There is no truth in any part of this statement, except what relates to the cost of the buildings, which was $4,094, as stated. The house was built, not in 1830, but in 1832, and has never been undermined by the sea and destroyed, nor has any expense been incurred for its protection.

"Musquito Inlet light-house, and St. John's River light-house."

The cause of the destruction of these two light-houses was fully explained in my report, laid before the Senate by the Secretary of the Treasury, 26th January, 1838, (2d sess. 25th Congress, Senate Doc. No. 138;) it was not, however, because they were badly built.

"Southwest Pass of the river Mississippi, erected in 1831 by Winslow Lewis, on a foundation of old flat-boat plank, at a cost of $10,011 75."

To show that this allegation of using "old flat-boat plank" for the foundation is unfounded, an extract from the contract is annexed, (marked C,) by which it will be seen that the tower was to rest on piles to be driven 40 feet, or as far as they could be driven with a weight of 1,400 pounds, falling 26 feet. This was a light-house of the first class, and
built in the best manner, of brick; and, to show that its destruction was not the fault of this office or the contractor, it is sufficient to mention that the place on which it stood is now passed over by vessels, as I am assured, carrying 18 feet water.

"The light-house at the South Pass" was equally well built, and of the same class, but was incapable of resisting the change of the current, produced and forced upon its base by violent storms, and during the past year it was prostrated also. For this light-house I have substituted a frame tower, at a moderate expense, which, in case the water shall approach it, can be taken apart and removed to a place of safety at a small expense. On all these waters, where light-houses shall become necessary hereafter, I would cause frame towers to be erected, and so constructed that they can be removed, from time to time, as occasion may require.

"Mahon's Ditch, erected in 1831, at a cost of $9,950; rebuilt by Winslow Lewis in 1839; cost unknown."

The cost of this light-house was not $9,950, but $4,975. It was necessarily placed in a wet salt marsh, frequently overflowed, and at length the foundation was so much injured, by the water acting on it, that it was found necessary to remove it to a place of safety; and this was done by Mr. W. Lewis, for $2,500. The original building and the removal of it, it will be perceived, cost $7,475, whilst the original appropriation for erecting the building was $10,000.

"Roanoke marshes, erected in 1831 by Winslow Lewis, and abandoned in 1839, as uninhabitable. An appropriation is now asked to rebuild it."

This light-house was not built by Winslow Lewis, but by Lucius Lyon, of Michigan, and was represented to be very well built. It was abandoned for three reasons. The first was, that the place never was fit for the location of a light-house, being a low marsh, overflowed at every high tide; and the second was, that the light-house required considerable repairs; and the third, that a man of the name of Van Pelt brought an ejectment against the keeper, and obtained a judgment in his favor, before the Treasury Department was made acquainted with the claim. Mr. McDonald, the then collector, who had procured a grant from the State, in the belief that the title was in it, never having informed the Treasury of the claim of Van Pelt, who, after his title was confirmed, asked more than the Treasury was disposed to give him. These reasons, combined, induced the Department to abandon the establishment about two years ago. No appropriation has been asked by the Department, with which to put up new buildings.

"Thomas's Point, Annapolis, erected in 1825, at an expense of $5,676. A sea wall was afterwards erected here, and in 1838 the tower was taken down and rebuilt, at a cost of $2,500."

This light was placed upon a clay bank at least 30 feet high, and about 500 feet from the water. Such was the action of the water upon the bank, that in a few years it was washed away to within 50 feet of the light; upon being informed of which, I directed a quantity of rubble stone to be placed at the base of the bank. This arrested the water but in a slight degree, and in 1838 it had approached within 15 feet of the light-house, when I contracted with Winslow Lewis to take down the tower, and rebuild it in a secure place, for $2,000. This case shows, as
clearly as anything can do, the danger which attends all such establish-
ments.

"Cumberland Island, erected in 1820, by W. Lewis, at a cost of
$17,000; rebuilt by him in 1838, at a cost of $7,000."

This house never was rebuilt, but it was directed to be removed to
Amelia island by the act of the 7th of July, 1838, and was accordingly
removed, and is now in use on Amelia island.

"St. Mark's, Florida, erected in 1831, (1829,) by Winslow Lewis, at
a cost of $11,765."

This was a light-house of the first class, and well built. The sea, how-
ever, approached its base in such a manner as to endanger the building,
rendering it necessary either to put up a breakwater around it, at a
heavy expense, or remove it to a secure position. I preferred the latter,
and caused the work to be done during the last winter. According to
a letter from the superintendent, a copy of which is subjoined, (marked
D,) the work has been faithfully done.

"Ocracoke light-house, erected by Winslow Lewis in 1823, at a cost
of $11,309 25; rebuilt in 1829, at a cost of $11,154."

This is a gross error. The first light-house built at Ocracoke was on
Shell Castle island, in the year 1798, and was built in connection with
the one on Cape Hatteras, by H. Dearborn, Esq. In process of time,
the channel leading in and out of Ocracoke left the light-house the dis-
tance of a mile, so as to render it altogether useless. The fact being
made known to Congress, an appropriation was made of $20,000, for
building another near the channel, and this was built in 1823, not by
Winslow Lewis, but by Noah Porter, of Massachusetts, for $11,359 35.
This house never was rebuilt, as stated, but is now in good preservation.

"Fairweather Island, erected in 1808; rebuilt in 1823, at a cost of
$2,300."

The first light-house here was built long before I had anything to do
with the establishment. It was blown down in a strong gale, on the 3d
September, 1821, and rebuilt by me, of stone, for the inconsiderable sum
of $2,300, in 1823. So important was it, however, to preserve the light
at this place, and so dangerous was its situation at all times, that the
people interested in it procured from Congress appropriations, from time
to time, to place and maintain a sea wall around the most exposed part
of the island.

"Turtle Island, Maumee bay, erected in 1831, at a cost of $3,830;
cost of repairs on foundation and sea wall, $3,968 47. Rebuilt in 1837,
at a cost of $6,800; cost of repairs in three years, for sea walls, &c.,
$7,900."

This statement is founded altogether in error. This light-house never
was rebuilt. The extraordinary rising of the lake reduced the island
from eight acres to about one acre and a half, and threatened to destroy
it entirely, and the light-house with it, in 1835 and 1836. At my re-
quest, Isaac S. Smith, Esq., who built the pier and light-house at Buffalo,
presented me with a plan for securing the island and light-house, which
proved effectual. It was to contract the island to one-half acre, drive
a double row of piles around it, filling in between the rows of piles with
rubble stone, elevating the island with the surplus part, which was mostly
sand; and upon this earth was to be brought and placed, from the main land. This was all done, under appropriations by Congress, and cost $16,700. On this point, extracts of two letters (marked E) are here-with enclosed.

"Stonington light, &c.," was noticed in a letter already before the committee.

I have the honor to be, very respectfully, your obedient servant,

S. PLEASONTON.

Hon. John P. Kennedy,
Chairman of the Committee on Commerce, H. R.

LIGHT-HOUSE ESTABLISHMENT.
[To accompany bill H. R. No. 432.]

MAY 25, 1842.

Mr. J. C Clark, from the Committee on Commerce, made the following report:

The Committee on Commerce, to which was referred the following resolutions, viz:

"Resolved, That the Committee on Commerce inquire into the expenditures of the light-house establishment since the year 1816, including expenditures for building and repairing light-houses, light-ships, beacons, and every work embraced under this general head, and make their report of the result of their inquiries; and also to examine into the propriety of reorganizing this establishment; of changing the mode of its super-intendency, and equalizing the compensation given to them and to the light-house keepers, and the keepers of other lights, buoys, &c., and the propriety of suppressing some of the posts of this establishment, and of so modifying the laws and practices under them in reference to this establishment as to secure strict observation of the duties of superintendents and keepers of lights; and to report the result of their examinations to this House, with such plans as they may agree upon, tending to reduce the annual expenditures of this establishment, and to improve the facilities and safety to navigation.

"Resolved, That the Committee on Commerce be instructed to inquire into the expediency of providing by law for a retrenchment of the expenditure and better regulation of the light-house department; and, also, whether the same ought not to be placed under the charge of the Topographical bureau."

Report, that they have had the same under consideration, and have given to the subjects therein contained the deliberation which their importance justly demands.

The tabular statement (marked A) annexed, furnished by the Fifth Auditor, gives the information sought by the first clause of the first resolution.

The committee propose, in terms as brief as possible, to speak of our light-house establishment; of the cost of construction; comparative expense of different years; cost of construction, compared with that of
British and French lights; expense of maintenance, in like comparison; efficiency of the lights; progress of improvement, &c.;—in a word, of all the matters referred to in the resolutions; and, first, as to the

**ORIGINAL COST OF CONSTRUCTION**

The committee have gone no further back than to the year 1791, when the number of light-houses was only ten, and the entire expense of that year was $22,000. From that period to the present the increase has kept pace with the rapidly-growing commerce and navigation of the country.

The present number of light-houses is 256

Do. do. light-boats 30

Do. do. beacons, without lights 35

Do. do. buoys, about 1,000

The total cost of the light-house, light-boat, beacon, and buoy establishment, (including cost of sites, buildings, repairs, maintenance, &c.,) from 1791 to 1817, was (round numbers) $1,872,000

Ditto, from 1817 to 1841 7,216,000

Total 9,088,000

Being an average per annum expense of about $180,000.

The total cost of building light-houses, (including cost of sites,) light-boats, beacons, and buoys, from 1791 to 1817, was $805,000

Ditto, ditto, ditto, from 1817 to 1841 1,910,000

Total 2,215,000

Deduct cost of beacons and buoys 500,000

Total for 286 light-houses and boats 1,715,000

Being an average of about $6,000; showing, in the opinion of your committee, great economy in these constructions.* Probably truer economy would have been consulted by more liberal appropriations for these works, thereby adding to their solidity and permanency.†

---

* The expense of beacons and buoys, from 1791 to 1819, was $267,783; from 1819 to this period, the expense has no doubt been greater, annually. During the latter period, the light-house and beacon and buoy accounts have been classed together, rendering it difficult to ascertain what the light-house establishment proper should be charged with. An expense of $10,000 per annum for beacons and buoys, from 1791 to 1841, is no doubt small enough; making, in the aggregate, $500,000.

† Since writing this report, the committee have received from the Fifth Auditor the annexed statement, (marked B,) giving the number of light-houses built since 1820, and the cost of each. From this statement it appears that the average cost of these light-houses, including cost of sites, is less than $5,300. The expenditures are less than the appropriation for those erections by more than $234,000.

From the statement furnished by the Auditor, annexed, (marked C,) it appears that the cost of the construction of thirty-three light-boats averages about $6,100, and that the expenditure for these constructions is less than the appropriations by $50,000; showing an aggregate expenditure for these objects of $282,000 less than the appropriations.
COMPARATIVE COSTS OF DIFFERENT YEARS.

The amount of expenditure of any given year, compared with that of another year, will appear more or less depending on the number of new constructions, either of houses or boats, in the respective years, the amount of repairs, cost of oil, &c. Some seasons are noted for the frequency and violence of their storms; in such years the expense of repairs will be great. The tables furnished us, therefore, will only enable us to draw conclusions for or against the economy of the general expenditure.

The entire expense of 1841 was $474,000; showing a large proportionate decrease of that of 1791, when, with ten light-houses, the expense was (as before stated) only $22,000. Had the expense remained in the ratio of the increased number of lights, it would have been, in 1841, $643,000.

In 1820, the number of light-houses, &c., was fifty-five. The whole expenditure for the year was $244,000. It should have been $842,000 in 1841, if the increase of expenditure had been in the ratio of the increased number of lights. And so of 1835; number of houses, two hundred and one; expenditure, $382,000. The expenditure of 1841 should have been $549,000.

For the last four years the amount expended, in comparison with previous years, for the building of houses and purchase of sites, has been great; but not, in the opinion of the committee, greater than the requirements of navigation demanded.

From 1837 to 1841, the aggregate amount of expenditure for all purposes was $2,176,000. Of this amount, there was expended, in the same time, for purchase of sites and buildings, $533,000; being more than one-fourth of the whole expenditure ($1,992,000) for the same objects for twenty-five years, from 1816 to 1841.

This large increase of disbursements was the consequence of the legislation of Congress in 1837 and 1838, in which years a large number of lights were ordered to be constructed. No blame can be justly chargeable to any one, certainly not to the administrative departments. But the committee think these expenditures were reasonable. All the light-houses erected in these four years were necessary and proper. That all the houses built previous to 1838, with perhaps two or three exceptions, are necessary to the prosecution of a successful commerce, is shown by the report of Lieutenant Manning, and other officers of the Navy hereinafter mentioned.

It has been hardly possible that an unnecessary light-house could have been built since 1837. In that year Congress, for the first time, very wisely directed the Board of Navy Commissioners to cause thorough examinations and surveys to be made, by competent officers of the Navy, of all the sites proposed for light-houses mentioned in the act of the 3d of March, in that year. These examinations and surveys were made. (See Executive Document, 2d session 25th Congress, No. 41.)

It appears, from the report of the Commissioners, that thirty-one of the proposed sites, contemplating an expenditure of $168,000, were condemned.

By the act of July 7, 1838, section 5, it was enacted "that in all
cases where appropriations are made in this act for the erection of new light-houses or new light-boats, to be established at places not before authorized by law, all such places shall first be carefully examined, and the most suitable sites selected," &c.

These wise precautions, worthy to be taken in all future legislation on this subject, as a general rule, preclude the belief that any light-houses have been constructed at improper points since the report of Lieutenant Manning and others, made in 1838. Since the act of that year, no new erections have been directed by Congress. The expenditures of 1839 and 1840 were in pursuance of that and previous acts.

It is hardly probable that the expense of any term of four years to come will equal that of the four past years. But a few new light-houses will be required on the Middle and Northern Atlantic coasts. The Southern, particularly the Florida coast, will need more. Thirteen light-houses have been erected in Florida, since its cession to the United States. For the last six years, the Indian war has prevented the building of any additional ones on the Atlantic side, although some have been authorized by law. When that war shall have terminated, the safety of navigation will no doubt be consulted by placing light-houses on some important and dangerous points in that quarter.

It is believed that, in usefulness, efficiency, and economy, combined, our Light-house Establishment will not compare with disadvantage with that of any other nation.

**COMPARATIVE COST OF CONSTRUCTION.**

From a report of the Secretary of the Treasury, made to Congress in 1836, (Ex. Doc. 1835-'36, vol. 3, No. 66,) it appears that the cost of light-houses in the United States is, on an average, $6,000; while in England they cost $19,000, and in France $8,000.

From a report of the Director General of France, (see report of select committee to House of Commons, August 8, 1834, Appendix R,) it appears that the average cost of building 13 light-houses, &c., in 1832 and 1833, was more, by some hundreds of dollars, than the estimate of the Secretary.

The same report shows (page 7) that the average cost of 12 British lights, built from 1820 to 1834, also exceeds the calculation of the Secretary.

The average cost of sites and building 13 lights in Ireland, under the Dublin Board, for 1820 to 1834, is more than $65,000. (P. 74, *ibid.*)

From an estimate made by Mr. Fresnel, French Director of Lights, (Appendix R, *ibid.,* p. 236,) it is shown that 31 lights, to be built in 1833, 1834, 1835, and 1836, would cost, on an average, about.. $20,000

Do. apparatus, lantern, lamps, &c.................................................. 4,500

Of these 31, 18 were to be of the first order, and would cost, on an average, for sites and building ........................................... 27,000

Do. apparatus, lantern, lamps, &c.................................................. 5,500
EXPENSE OF ESTABLISHMENT, COMPARED WITH THAT OF ENGLAND AND FRANCE.

From a report of the Fifth Auditor, made to Congress October 1, 1835, it appears that the average expenses, per annum, of sustaining each light-house, including repairs, salaries of keepers, oil, &c., was $911. Do. light-boats .................. 2,862 Do. light-houses in England........................................ 2,268 Do. light-boats in England ........................................ 5,922

From the report of the select committee referred to, (page 30,) the average expense of each of the lights is as follows:
36 light-houses, England, under Trinity Board............... $511
34 do. Ireland................................. 500
22 do. Scotland ........................................ 514

Average........................................................................ 508 $2,450
American, as above........................................ 911

Difference in favor of American......................... 1,539

EXPENSE OF LIGHT-BOATS.

13 boats, England............................................. $1,334
3 do. Ireland............................................ 1,080

Average............................................................ 1,207 $5,841
American, as above........................................ 2,862

Difference in favor of American boats...................... 2,779

From a report made by the Trinity Board, to which is intrusted the management of the British lights, made to the House of Commons in 1837, the expenses are thus stated:
42 light-houses, average expense.............................. $2,610
13 floating lights, do. ........................................ 8,381

For the year ending June 30, 1837, the expenses for the same services in the United States, were as follows:
212 light-houses, average........................................ $1,115
27 floating-lights............................................. 2,331
Average expense of British lights......................... $5,495
Do. American............................................... 1,753

Difference in favor of American............................. 3,742

Being more than 200 per cent. in favor of American economy in this branch of the public service.

Besides, in England, commerce is heavily taxed, in the form of light money, by the owners and lessees of light-houses, for their own emolu-
ment, and for the support of pensioners and charities. There are fourteen light-houses thus owned. The promptings of individual sagacity and private interest will usually insure the performance of any enterprise or the sustaining of any establishment with an economy much exceeding that used by agents of Governments. But the private lights in England are kept up at an expense much exceeding that of the United States.

Fourteen lights in hands of private persons in England, 1834:

Gross amount of collections .................................. £79,676
Allowance for collection ...................................... £10,244
Expense of maintenance ...................................... 9,100

Profit .......................................................... 19,344

Profits .......................................................... 60,332

Average expense of maintenance, £650 = $3,140; 180 per cent. more than American expenditure. (See same report, p. 37.)

The annual expense of maintaining private lights of the first class is much larger; being, on an average, $4,760. (Ibid., p. 41.)

The expense of the third (smallest) class of individual lights is (average) $2,490, being 120 per cent. more than the American lights, great and small.

This comparison is highly favorable to the economy of our system.

COMPARISON WITH FRENCH LIGHTS.

The report of the select committee referred to, (page 31,) states the annual charge of maintaining a lens light of the first order to be £340, say $1,640; but this is exclusive of repairs.

In all the French accounts of "expense of maintenance," repairs are excluded; so says M. Fresnel, principal engineer. (See ibid., Appendix R.) M. Fresnel says: "These (the British) expenditures are found mixed up with each other, (that is, cost of maintenance and repairs;) hence the impossibility of arriving, with any degree of certainty, to a comparative estimate of the two services, (French and British."

Our accounts are mingled in the same way; hence the like difficulty of instituting a comparison with the expenses of the French lights.

That the expenditure of the French establishment should be less than ours or that of Great Britain, would excite no surprise, when the relative cost of labor and oil is taken into the account.

The British committee, (page 31,) after commenting on the unequal expenditure in the maintenance of French and British lights, say:

"In explanation of this difference, it must be observed—

"1st. Salaries to light-keepers in England are understood to be nearly double those in France."

"2d. The price of spermaceti oil used in England is stated to be double to the oil de colza used in France."

Wages in this country are much higher than in England even; and we also use sperm oil. Yet, notwithstanding the great inequality in
the salaries of keepers and the cost of oil, it will appear, from the evidence furnished by M. Fresnel, that the management of our light establishment cannot justly be reproached with want of prudence and economy.

M. Fresnel says (see page 229, appendix,) that the annual expenditure of a light of the first class (exclusive of repairs) is $1,615.

The annual expenditure of a light of the second class (exclusive of repairs) is $1,330.

The annual expenditure of a light of the third class (exclusive of repairs) is $684.

Average $1,208

Some 9 per cent. more than the cost of American lights, including cost of repairs.

The report (page 233) gives the expenditure of some of the lights specifically, from which it appears that the cost of maintenance is much larger than the above account of M. Fresnel, viz:

<table>
<thead>
<tr>
<th>Light</th>
<th>Annual Expenditure (exclusive of repairs)</th>
<th>Cost of Repairs</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cordovan light, first order</td>
<td>11,598 frs.</td>
<td>950</td>
<td>3,154</td>
</tr>
</tbody>
</table>

Ushant light, first order, (page 285,) ordinary annual expenditure (exclusive of repairs)........ 9,000 frs. $1,170

St. Mathieu light, second order, ordinary expenses (repairs excluded)........ 6,000 frs. 1,140

The average annual expense of these three lights (exclusive of repairs) is $1,685; exceeding by 50 per cent. the average expense of American lights.

The most expensive American light is that on Frank's island, having two keepers, and, in 1841, amounted to $1,806 23, as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeper's salary</td>
<td>$600 00</td>
</tr>
<tr>
<td>Assistant</td>
<td>360 00</td>
</tr>
<tr>
<td>Oil, 779 gallons</td>
<td>779 00</td>
</tr>
<tr>
<td>Tubes, glasses, &amp;c.</td>
<td>68 23</td>
</tr>
<tr>
<td>Window glass and putty</td>
<td>9 00</td>
</tr>
</tbody>
</table>

The average expense of the Cordovan and Ushant lights, both of the first order, was $1,957, being more, by $151, than the Frank's Island light.

The little experience we have had in this country in the use of the French lenticular apparatus induces the belief that our anticipations in regard to the saving of oil will not be fully realized.

The two lights on the lens plan, at Navesink, consume per annum 1,095 gallons of oil; they consumed, on the old plan (thirty-one Argand lamps) 992 gallons of oil.

21 L H P
This consumption of oil is about the same as that of a lens light of the first order in France.

It is said in the report (ibid., page 32) that "the consumption of oil in the Cordovan light-house is equal to that of seventeen Argand lamps." The average consumption per annum of such a lamp is thirty-five gallons, which gives to the Cordovan light a consumption of 595 gallons per annum, being 9 per cent. more than that of one of the Navesink lights.

The French manufacturer of the lenticular apparatus claims for it a great saving of oil. Further experience in this country may demonstrate the reality of this claim. But it remains to be proved to what extent, if any, such saving may be carried.

The communication of M. Lepaute, the manufacturer, to Governor Davis, (see Senate Doc., 1st sess. 26th Congress, No. 474,) in which he attempts to show the difference in the consumption of oil in the French and American lights, does not inform us on what authority the quantities of oil consumed in the American houses are given. With the best intentions to give the quantities correct, he may not have been in possession of the true account of them.

He puts down the quantity consumed at the two Navesink lights, under the old plan, at 1,135 gallons, but the amount consumed was 992 gallons only, a mistake of 15 per cent. in favor of his statement. He also puts down for the use of lens lights at that place 800 gallons, but we consume in them 1,095, a mistake of 37 per cent. in favor of the lens lights. The two mistakes combined show more than 50 per cent. in favor of the lenses.

In like manner he puts down the consumption of oil at Frank's Island light, at the mouth of the Mississippi, at 1,050 gallons, but the true amount is only 779 gallons, an error of 35 per cent. Should the same errors extend through the whole of his table, (and the committee have examined these two cases, being the only ones before them showing the actual quantity of oil consumed,) the result, as stated by him, will hardly bear close examination.

It has been said that the French lights are superior to those of any other nation. Their sea lights are no doubt excellent. They have kept pace with the march of science and the improvements of the age, but it is doubted whether their claim to any considerable degree of superiority can be successfully maintained.

The British select committee (ibid., p. 31) say "the British lights are considered generally very good, and sufficient for the purposes they are intended for, and superior to the generality of French lights, many of which are harbor lights, and, perhaps, small in comparison with the sea lights."

PROGRESS OF IMPROVEMENT IN AMERICAN LIGHTS.

Previous to 1810, the then common lamp was used in all our light-houses; the lanterns were glazed with common glass, of no great purity. In consequence of the small size of the panes, the number and bulk of the sash obscured much of the light. The smoke from the lamps, soil- ing the glass, added much to the obscurity; besides, the consumption of oil in these antiquated lamps was enormous.
In that year, Mr. Winslow Lewis, a shipmaster thrown out of employment by the embargo in 1807, and who, from that year to 1810, employed his time in experiments with a view to improve the condition of our light-houses, was authorized by Government to place the reflectors of which he was the patentee in the Boston light-house. The consequent improvement in the character of the light, and the economy of expense in the saving of oil, were subjects of high commendation by the Government. (See State Papers, vol. 10, p. 879, &c.) A committee of the Boston Marine Society examined the Boston light; their report (ibid., p. 882) says that the light was visible at the distance of eleven leagues; that the new could be seen a distance of five leagues further than the old light; and that the saving in oil was equal to 200 per cent. In the same year one of the light-houses on Thatcher's island was fitted up in the same way. Mr. Dearborn, the collector of Boston, examined it, with others, minutely, in comparison with the other light, burning on the old plan. He says, in his letter to Mr. Gallatin, (ibid., p. 880,) that at the distance of seven leagues the contrast between the two lights was striking—the one as a "large brilliant star" to a "small star;" and that there was a saving of oil equal to 100 per cent. Again, in speaking, under date of June 27, 1811, of Boston and Cape Cod light-houses, (for the latter had been fitted up with the new lamps,) he says that the light can be seen at a much greater distance than the old lights, and requires less than half the quantity of oil. The saving of expense in oil in these three light-houses was not less than $1,900 per annum.

The success of these new lights was so complete that Congress passed, in March, 1812, an act authorizing Mr. Gallatin to contract with Mr. Lewis for fitting up all the light-houses (49) on the improved plan. The contract was accordingly made on the 26th of March of that year, Mr. Lewis giving bonds, in the sum of $60,000, conditioned that the new lights should be better than the old, and that one-half the expense in oil should be saved. All the light-houses were not completed until in the fall of the year 1815, when the contract was fulfilled, to the entire satisfaction of the Government. The commissioner of the revenue, Mr. Smith, then general light-house superintendent, in a letter dated January 17, 1817, (State Papers, vol. 11, p. 44,) says: "The fidelity with which Mr. Lewis is understood to have fulfilled his engagements, added to the experience which he has acquired, recommends him as the most eligible organ for the continued performance of these services"—fitting up new light-houses with patent lamps and reflectors.

On the 1st day of January, 1816, Mr. Lewis contracted with the Government to furnish best sperm oil for all the lights for seven years, and to visit every light-house personally once a year, and report its condition to the proper bureau, in consideration of being allowed annually one-half the oil consumed under the old plan. It was renewed at its expiration for five years, from only one-third of the oil. These contracts were faithfully executed.

Since 1828, Mr. Lewis has been extensively engaged as a contractor for building light-houses for the United States. His intimate acquaintance with and practical knowledge of the business has enabled him to become a successful competitor for building many of them since that
About eighty of them have been constructed by him. It is believed by the committee that he has been faithful in the discharge of all his engagements to the public. To his active exertions our lighthouse establishment is much indebted for its present highly-improved condition.

Within a few years past, further improvements have been made in the size and quality of the reflectors, and the quality of the glass with which the lanterns are glazed. The 21-inch improved parabolic reflectors are made in this country, at an expense, including the lamps, of eighty dollars, in dies or moulds, (instead of being hammered, as formerly,) plated with 16 ounces of silver, and highly polished. The lanterns are improved by substituting for panes of common glass, 8 by 10 or 10 by 12, plate glass, 20 by 24 inches.

In 1839, the Boston and Cape Cod lights were fitted up with these reflectors.

In 1840, Faulkner's Island, Stonington, and Tybee beacon lights, ditto.

In 1841, Thatcher's Island, (two, Scituate, Chatham, (two,) Newport, Cape Henry, Old Point Comfort, New Point Comfort, Wolf Island, (two,) Thunder Bay, and White Island, ditto.

The cost of fitting up a house with a new lantern, with 15 lamps and 15 21-inch reflectors, is about $8,500.

The cost of fitting up a house with 10 lamps and 10 14-inch reflectors is about $2,000. (See statement annexed, marked D.)

These improvements have added to the ordinary expenses of the establishment, since 1839, about $50,000. It is the intention of the superintendent to fit up all the principal light-houses in the improved style, when the condition of the Treasury will warrant the expense—a purpose which meets with the approbation of the committee, as they doubt not that thereby the brilliancy and efficiency of the lights will be still further increased.

During this season, it is proposed to refit only two lights, viz: Charleston and Tybee.

A few years previous to 1830, a new mode of lighting was introduced into France, the merit of which is said to be due to Dr. Brewster, though it was, about the time of its invention, adopted in France by M. Arago and M. Fresnel. It is called the lenticular or diopteric, as contradistinguished from the catoptric plan. The former, by the aid of lenses, refracts, the latter, by reflectors, reflects the light. For a particular mention of this plan and apparatus, see Gov. Davis's report, (Senate Doc. 1837–38, vol. 5, No. 428;) also, select report to House of Commons, p. 321.

In 1880, the Fifth Auditor, anxious that the country should avail itself of every improvement calculated to give efficiency and economy to the system, wrote to our consul at Paris, Mr. Barnet, to be informed of the merits of the invention. He was answered, that it was then yet considered an experiment in France, and he was advised to await its results. At a subsequent period he again wrote in regard to the cost, and was answered that a first-order lens light would cost $5,000, and a
third-order $2,000. The great difference in expense, compared with the merits of the two plans, prevented the superintendent from giving order for their introduction into this country. Nothing more was done until 1838, when the attention of Congress was called to the subject by the report of Governor Davis. An act was passed July 7, 1838, authorizing the purchase and importation of two sets of this dioptic apparatus—one of the first and one of the second class. The purchase was made, and they were put into operation in the two Navesink light-houses not far from Sandy Hook, in March, 1841. (See letter of Auditor, marked E.)

The whole expense of purchase, transportation, and fitting up, exclusive of work on the towers, was about $10,000 each—a cost much greater than that for which they might now be completed. Congress, and those more nearly interested in commerce, were anxious to try them. To prevent any failure, the Fifth Auditor employed a competent man at Paris to come over and put them in operation. They were unknown in this country, and it was believed that no one here was capable of arranging them correctly. (For a more particular account of this matter, see the letter of the Auditor, marked E.)

It is not believed that dioptic lights of the first order can be required at any points, except a few, and those the most important outer sea stations. The remarks hereinafter made in regard to the comparative efficiency and economy of French and American lights, and the letter of the Auditor, may suggest doubts of the propriety of using any of the first order.

The British select committee, in their report, (page 32,) say "the consumption of oil in one of those (largest French) lenses renders its use not advisable for light-houses where a small number of burners suffice."

Those of the third and fourth order, the former having a portee of fifteen and the latter of ten miles, may be found after due trial worthy the patronage of the Government.

The Fifth Auditor recommends the purchase of one set of the third order, to be tried in the Long Island Head light, in Boston bay. The whole cost will be about $4,500. The committee recommend an appropriation of that sum for that purpose.

In arranging lights, useful effect and expense should be looked at in one view. An outer or sea light should have a "portee" or reach of light sufficient to give the approaching vessel, in all weather, timely notice of danger. Any expense in fitting up lights to produce more effect is useless. A light extending its limit of visibility to the distance of twenty-five miles is as efficient and useful as one of greater range. The mariner sees it in ample time to shape his course, free from all difficulty.
COMPARISON OF AMERICAN AND FRENCH LIGHTS, IN REGARD TO REACH OF LIGHT.

French.

1st order, average portee about $6\frac{1}{2}$ leagues—20 miles.
2d do. do. do. do. 6 do. 18 do.
3d do. do. do. do. 5 do. 15 do.
3d do. (small) do. do. 4 do. 12 do.
4th do. do. do. do. 3 do. 9 do.
Harbor and watch lights, 1½ do. 5 do.

1st order, 27, viz: 2 of 9 leagues portee—27 miles.
3 8 do. do. 24 do.
4 7 do. do. 21 do.
18 6 do. do. 18 do.

2d order, 2,
2 6 do. do. 18 do.
3d do. 8,
8 5 do. do. 15 do.
3d do. (small) 3,
3 4 do. do. 12 do.

4th do. 34,
34 3 do. do. 9 do.

Harbor lights, 32,
19 2 do. do. 6 do.
3 2\frac{1}{2} do. do. 7\frac{3}{4} do.
4 1\frac{1}{4} do. do. 4\frac{1}{2} do.
5 1 do. do. 3 do.
1 ½ do. do. 1\frac{1}{2} do.

Whole number, 106.
Average of the whole, say 14 miles.
Average of 1st, 2d, 3d, 3d, (small,) and 4th orders, say 15 miles.

The committee are unable to give the reach of visibility of all the light-houses in the United States. The limits of those which have been ascertained warrant the conclusion that they are, on an average, larger than the French lights.

Professor Paine, of Cambridge College, in 1838, made a survey of twelve light-houses in Boston bay and vicinity. (See House Report, 3d session 25th Congress, No. 187.) He says: "I therefore feel myself warranted in drawing the following conclusions: that, in ordinary clear weather, our best lights, such as the Boston, Highland, Scituate, &c., are visible from the masthead of a square-rigged vessel about 25 miles; that our second class of lights, such as those on Thatcher's island, Eastern point, the high light on Baker's island, and those on Plum island, are visible 20 to 22 miles; and that the third class, such as those at Straitmouth island, Ipswich beach, Squam, Marblehead, and Long Island head, are visible from 15 to 18 miles."

Lieutenant Bache, in his report, to which reference has been made, gives the ranges of visibility of fifteen lights, varying from 19 to 12 miles, and averaging 14 miles. Of these lights, 8 were of the third class, having only 9-inch reflectors; 5 of the second class, having 14-inch reflectors; and 1 of the first class, with 18-inch reflectors.

Mr. Lewis gives a statement of the portees of all the lights of the first class, from Passamaquoddy to South Pass entrance of the Missis-
sippi, in November, 1839, ranging from 15 to 30 miles, and averaging 24 miles. (Senate Doc. 1837-38, vol. 2, No. 188.)

Mr. Frick, superintendent of lights at Baltimore, gives the portees of 12 lights in the Chesapeake, ranging from 10 to 20 miles, averaging 15 miles. (Ibid.)

Mr. Anderson, superintendent at Portland, Maine, says that 15 harbor lights in that vicinity can be seen from 12 to 18 miles. These are not intended to be seen at sea. Also, that 12 coast lights in the same vicinity can be seen from 5 to 10 leagues. (Ibid.)

It appears, from a list of the light-houses published by the superintendent in 1839, that the average "reach of light" of 76 light-houses (that being the number whose reach is given) is 19 miles. The average "reach" of 6 of our best lights (Navesink, Montauk, Baker's island, &c.) is 27 ½ miles.

The committee believe that the statements of average distances of extreme visibility made by Professor Paine are true in regard to all our lights.

The average reach of light of 170 British lights, as shown in the British list published at the Hydrographical Office, Admiralty, in 1832, is less than 14 miles. The average reach of 6 of their best lights (Needles, Beachy head, Lundy, &c.) is 28½ miles.

The list of American lights is made out by the superintendent, in close imitation of the British lists. It gives the name of the light and State, place in which situated, latitude and longitude, number of lamps, size of reflectors, character of the lights, time of revolution, (if a revolving light,) reach of light of a part, height of lantern above high-water mark, height of towers from base to lantern, year in which built, and remarks.

It seems to the committee that the information contained in this list is as full and perfect as it well can be. That a few mistakes may be found, is probable.

In addition to the evidence furnished by the lists of British and American lights, in regard to their comparative reaches of light, the documents of the House last referred to contain the testimony of many highly respectable shipmasters, proving that our lights are in nowise inferior to the British. These masters were old seamen, who had from eight to twenty years been constantly employed in making voyages to England and France. All agree that our lights can be seen as far and as distinctly, and that our establishment is as well regulated, as that of any European nation. That document contains the charges then brought before Congress against the establishment, and, in the opinion of the committee, their triumphant refutation.

The Boston Marine Society, under date of January 2, 1838, Resolved, "That, in its opinion, the general character of the lights on this coast is good, and that much credit is due the Department under whose superintendence the light-houses are placed, for the good order which the light-houses now evince, and the exertions to maintain efficient lights."

If our establishment is wanting in order and efficiency, it might be supposed that we should hear complaints from those who travel, by night and by day, on the perilous highways, made comparatively safe by the light which it throws upon them. The committee are ignorant of a
complaints from that quarter. The captains of our ships and packets, men having the nearest interest in and most competent to speak of the subject, send us no memorials in complaint.

Out-of-door fault-finding, coming from those who have never trod a deck, and perhaps from some who, in their great zeal for change, and by their attendance upon the lobbies of Congress, subject themselves to the suspicion that personal and private considerations, and not the public good, stimulate them to action, should be listened to with distrust, and taken with much allowance. When the masters and owners of our commercial marine shall lay their complaints before Congress, and ask for improvements in our public lights, the time will have arrived when the question of reform should be thoroughly discussed.

In comparison with the progress of improvement in the Old World, our march in this, as in almost every other useful establishment, has been extremely rapid. In the comparatively short period of fifty years, we have built 276 light-houses and boats. Since 1812, the useful effect of our lights has been nearly doubled, and the consumption of oil lessened by more than 50 per cent. For centuries before our existence as a nation England and France had been commercial nations; but, up to the close of the last century, no improvement had been made in the quality of their lights. About that period oil was substituted for coal. At the close of the year 1812 we had forty light-houses fitted up with patent lamps and parabolic reflectors. At that time both England and France had not ten houses thus fitted up.

It is believed that, when the improvements now in progress shall have been effected, (in connection with a proposed change in the mode of inspection,) our system will be more efficient, useful, and economical, than that of any other nation.

ORDER, MANAGEMENT, AND LOCATION.

It is understood that but few complaints are made, by those most immediately interested, touching the management of the lights by their keepers. In an establishment so vast and widely extended, that there should be occasional delinquency, is to be expected. It must be viewed as a whole. That a few bad light-houses and bad keepers may be pointed out is quite probable; but this proves nothing against the general goodness of either, or the general correct management of the system.

The report of Lieutenant Manning and others, officers of the Navy, (Ex. Doc., 3d Sess. 25th Cong., No. 24,) shows that, generally, the lights were well conducted, and that the lighting apparatus was in good condition. Many of the houses were out of repair. This will and must be the condition of some of them every year. They are much exposed to the violent action of the elements, and are liable to get out of repair. Under the act of July 7, 1838, the Atlantic coast was divided into five districts; to each of which was assigned a lieutenant of the Navy, who were, in pursuance of said act, instructed by the Secretary of the Treasury to make inspection of all the light-houses and boats, buoys, beacons, &c., in their respective districts, and to report upon their condition and usefulness; and also
further to report whether, in their judgment, the public interest requires any modification of the system of erecting, superintending, and managing said light-houses, light-boats, &c.

The first district, extending from Eastport to Boston, was assigned to Lieut. Manning. He examined forty-one lights, the whole number in his district. He reported them, with the exception of three or four, some "in order," some "in good order," and others "in very good order." He says that there was a general complaint by the keepers that the oil was bad, on the ground that it congealed in cold weather. In a cold climate this is unavoidable, unless oil heaters or stoves are used. The best of oil will become hard when the thermometer (Fahrenheit) is down to 34.

Lieut. Manning, although he does not recommend the discontinuance of a single light-house by name as unnecessary, says: "It may be that all the lights on the coast of Maine are required, but I should suppose that some of them might be dispensed with." That was the object of his visitation, and it is to be regretted that he did not ascertain what lights, if any, should be extinguished. He, however, as an apology, complains that he had not sufficient time to make the necessary observations. If mariners become confused, owing to the multiplicity of lights, it is presumed that either Congress or the Department will be informed by them of their complaints, and made acquainted with proposed remedies. The committee are ignorant of the existence of such complaints.

The second district, from Boston to Newport, (twenty-eight houses,) was inspected by Lieutenant Carpender. He reported eleven of them as being badly kept. They must have improved greatly since. Governor Lincoln inspected five of them in 1841, viz: Scituate, Barnstable, Mayo's Beach, Cape Cod, and Nauset; and Mr. Collector Norton one—Nantucket harbor. They report them in fine condition. In 1840, Mr. Knowlton (who visits the houses annually to deliver oil, inspect them, and make any necessary repairs to the light apparatus) inspected Scituate, Plymouth, Mayo's, Cape Cod, and Chatham lights, (the latter being one of the eleven reported by Lieutenant Carpender,) and reported them to be in good order. He also reported the same of Cuttyhunk, Dumpling Rock, and Clark's Point, which had the ill luck to come within Lieutenant Carpender's condemnation.

Lieutenant Carpender reported many of the houses out of repair. As before remarked, repairs are yearly demanded in a greater or less degree, and always will be, under any administration of the system. Since that report, extensive repairs have been made, and will continue to be made, so long as light-houses must be placed in highly-exposed positions.

He recommended a reduction of the lights in nearly all the houses, and a different arrangement and coloring of many of them. His suggestions in regard to some of the lights may be judicious; but a general change in the arrangements of the lights on that important portion of our coast would seem to be improper, and might lead to many disastrous results. Every mariner competent to take charge of a vessel is familiar with the position, bearing, number, color, and character of the lights. A general change in their arrangement would lead to much uncertainty
and confusion, and, while the mariner was learning to distinguish them, an immense sacrifice of life and property might be the result. That Lieutenant Carpender performed his duties with an honest zeal the committee do not doubt. His report shows that he was deeply imbued with the spirit of the age—change.

In this connection, the committee refer to the opinions of the collector of Portland, and other collectors, and of many citizens in this district—Lieutenant Manning's. (See paper marked F, annexed, and accompanying papers.) Seventeen citizens, being shipmasters, owners, and interested in navigation, state "that there are not too many lights on the eastern coasts, but that they are of opinion that more light-houses might and ought to be located in several places and harbors along the coasts, now of difficult and dangerous access in dark and stormy nights; and some of us, masters of vessels, having sailed on the coasts for a long time, know from experience the want of lights in several places that we now have in our mind's eye." The collectors of Portland, Kennebunk, Frenchman's Bay, York, Waldoboro', Saco, Machias, Wiscasset, Bath, Passamaquoddy, and Castine, all agree that no one light can be dispensed with, and that they are sufficiently distinguished.

Captain Walden, of the revenue-cutter Morris, states that Hendrick's Head and Pemaquid Point lights are useless.

Captain Whitcomb, of the cutter Alert, is of opinion that Bear Island or Mount Desert light might be dispensed with.

The force of these opinions is much weakened by the combined testimony of all the collectors, that none of the lights can be dispensed with. The collector at Bath differs from Captain Walden specifically in regard to the Hendrick's Head light. He says: "It seems to be universally conceded that it could not now be discontinued without serious consequences resulting." The collector at Wiscasset examined particularly this light-house, and says that it is useful. The collector at Belfast thinks that the light is important to vessels going into Sheepscot river.

This collector also differs from Captain Whitcomb in regard to Bear Island light, and refers to the opinion of Captain Doyle, who, in his last voyage from Eastport, would have lost his vessel, with a valuable cargo, had it not been for this light.

The weight of testimony is decidedly in favor of all the lights.

The letter of Captain Sturgis, of the revenue cutter on the Boston station, is also annexed. He says "that, from twelve years' personal observation, the light-houses on the eastern coast are properly located, and that they are the dependence of the immense coasting navigation of this section of the Union, and that he is surprised that any person should assert that there were too many, or that any number could be discontinued without great hazard to commerce."

Captain Sturgis also bears strong testimony in favor of the ability and faithfulness of the keepers. The report of a committee of the Boston Marine Society, appointed at a special meeting of the society, held on the 8th of April, 1842, is also annexed. The committee had before them the complaints and charges of a Mr. J. W. P. Lewis, against our light-houses. The committee report that "they feel warranted in expressing an opinion that the lights generally on the American coast have
been much improved, and that they are in a better condition now than they ever have been before."

In regard to the number of light-houses on the coast of Maine, the committee say that "they have sought for information on this subject from various persons well acquainted with the navigation of that coast, (among them are commanders of vessels and pilots,) and all with whom they have conversed have expressed an opinion that the lights are not too numerous, that none can well be dispensed with, and that they are in good and satisfactory condition."

The committee have examined the reports of the collectors, acting as superintendents, of their inspection of the lights in their respective districts, made in 1841. With a very few exceptions, these reports speak in terms of commendation of the good order and management of the lights, and of the lamps and apparatus connected with them. The remarks of Governor Lincoln, in his report, will apply to all these reports. He says, "upon a review of his report, that the light-houses in his district are, in the general, in good condition and well kept."

Lieutenant Bache inspected the third district, from Newport to New York, and up the Hudson, (54 lights.) He complained of only four light-houses as being badly kept.

The fourth district, from New York to Norfolk, (52 lights,) was inspected by Lieutenant Porter. He reported only four light-houses as being improperly kept.

Lieutenant Hollins inspected the fifth district, from Norfolk to Key West, (29 lights.) He reported all of them kept in good order, and many of them in excellent order, except three—North Island, Cumberland Island, and Northwest Passage light-houses, and Wade's Point light-boat.

The sixth district was examined by Captain Rosseau, and the seventh by Lieutenant Homans. Their reports were equally favorable. In the opinion of the committee, these reports furnish no proof against the general good management of the establishment.

In the location of some two hundred and twenty light-houses, (about the number in 1838,) it might have been expected that some of them would have been placed at points furnishing no aids to navigation, and involving in their construction unnecessary expenditure. The only surprise is, considering the information on which Congress had, from time to time, authorized these erections, that many, very many, of the light-houses are not only useless, but worse than useless. Previous to 1837, the information on which Congress acted consisted of allegations and statements set forth in petitions and memorials, often, no doubt, prompted by local considerations and individual interests, and communications from the Treasury Department, founded on the best knowledge within its reach. This was necessarily imperfect, as previous to that period no examinations or surveys were directed to be made by scientific and competent officers of the Government.

In the report referred to, but three lights, specifically, are recommended to be extinguished. Lieutenant Carpenter recommends the abandonment of two of the towers at Nauset beach, Massachusetts, and to substitute one red revolving light for three fixed white lights. The
erection of these three towers was, upon examination and survey, under the act of March 3, 1837, strongly recommended by Captain Percival, of the Navy. (See paper annexed, marked G.) Which of the reports is most to be relied on, that of Lieutenant Carpenter or of Captain Percival, the committee have no means of ascertaining. Neither Congress nor the Department are in fault for constructing these lights, should the report of Lieutenant C. prove to be correct. Lieutenant C. thought the Mayo’s Beach light was unnecessary.

In Lieutenant Bache’s district he found but one light, (Poplar Point,) of the general usefulness of which he entertained a doubt. He admits that it is serviceable to the trade of North Kingston and Wickford.

Lieutenant Porter says “the present sites for light-houses in the fourth district have been judiciously selected.”

SUPERINTENDENTS AND KEEPERS, AND THEIR SALARIES—INSPECTORS.

Forty-four collectors act as superintendents of the lights in their respective districts. By the act of May 7, 1822, their maximum compensation per annum is $400. Some four or five receive that amount; the others receive from $100 to $200 each per annum. These superintendents are required to visit the light-houses but once in each year. Captain Howland, who is in the employ of the Department, also visits them once in each year, and makes reports of their condition, &c., to the Fifth Auditor.

In the opinion of the committee, there should be established a plan of inspection more efficient. Frequent visitations and minute examinations, by competent inspectors, would insure vigilance, economy, and order, on the part of the keepers. The inspectors should be men thoroughly acquainted with all the details of light-house management and superintendent, with the manner of adjusting the lamps and reflectors, and of keeping them in good order.

Frequent reports from them to the general superintendent would enable the latter to judge of the faithfulness and ability of the keepers, of the amount of the necessary repairs, of the quality of the oil consumed, of the quality of the lights; in a word, with all the minutiae of the establishment.

The collectors, acting as superintendents, cannot possess that information and practical knowledge necessary to a perfect administration of the system. The mode of conducting it has formed no part of their studies. They lack both theory and experience.

In a report made to the Senate, from the Committee on Commerce, by Governor Davis, in 1838, (see Sen. Doc., vol. 5, 1837—38, No. 428,) this subject is noticed. He says: “The lights should be visited by a general inspector, who is master of the whole subject, being fully capable of estimating the true character of the apparatus, its condition, the manner in which it is managed, whether the keepers are capable and faithful, and whether the oil is such as it should be. In short, this visitor should be so thoroughly skilled in everything pertaining to the subject, as to keep the light-houses in as perfect condition as the arts and the progress of science will allow.” Again: “We have already said certain col-
ectors of the customs are the inspectors of the light-houses in their respective districts. It is manifest the two offices have no natural connection, for they require qualifications quite different. The one should understand the laws of light, as it is affected by reflectors and refractors; the other, the character and the value of merchandise; and there is no affinity between the employments; nor does it follow that one who is well qualified for a collectorship has a particle of that information which is essential to a well-conducted system of lights." Again: "The number is great; the duty is merely collateral; their visits are seldom; their attention little engaged in the matter. They have no control over the system, have no knowledge beyond their districts; and the consequence is, that their inspection is generally of little importance, and has little tendency to expose the faults or improve the character of the system. Indeed, so necessary is some other inspection, that the contractors who furnish oil are required to view and report upon the condition of each light; and so, also, are the immediate keepers. The subject was early committed to the collectors as a matter of convenience; but we may well inquire now whether its importance does not call for a more skilful supervision—one that can give harmony and character to the whole system, and make it not only keep pace with the progress of population and business, but with the advancement of mechanical and scientific improvements."

In the opinion of the committee, these views are entitled to the respectful consideration of Congress.

The appointment of inspectors, whose duty it should be to devote their entire time, under the direction of the general superintendent, to frequent examinations of the light-houses, light-boats, buoys, &c., would be attended with no great increase of expense. The amount now paid to the collectors acting as superintendents is about eleven thousand dollars. There is already attached to the establishment a small vessel. That, with the addition of another, and the salaries of two inspectors for the two districts on the Atlantic coast, bays, &c., if two should be deemed necessary, the increase of expense will be inconsiderable. The frequent reports of these inspectors to the general superintendent would enable him at all times to know the precise condition and order of the establishment, and to increase its efficiency, usefulness, and economy.

The resolution directs an inquiry into the propriety of equalizing the pay of the superintendents and keepers. From what has been said in regard to the pay of superintendents, it is manifest that their salaries are moderate, and that they are distributed in proportion to importance and service. The same remarks are equally just, applied to the salaries of the keepers—the lowest being $350, and the highest $600. These are fixed by the Secretary of the Treasury, under the act of May 23, 1828, by which he was authorized to allow such compensation as he should think proper, having reference, of course, to the relative amount of service, not exceeding an average of $400.

The salaries of keepers of floating lights were fixed by act of 26th of May, 1824, for those at sea, $700; and those on the bays and sounds, at $500—a compensation, in the judgment of the committee, not unreasonable.
From July, 1820, when the number of light-houses was 55, to the present year, when the number of light-houses is 256, of light-boats 30, of beacons about 35, and of buoys nearly 1,000, the establishment has been under the charge of the present general superintendent, the Fifth Auditor of the Treasury. It might well be expected that a twenty-two years' service would have given to the incumbent an experience and a practical knowledge of his business, which should not, for slight causes, be lost to the public. A transfer of his duties to other and inexperienced hands could not but be attended with derangements, and, probably, with an increased expenditure. It has now a good degree of method, system, and economy; and with some improvements, particularly in regard to inspection, it is believed that our establishment may, with no disadvantage, compare with that of any other nation. Every innovation is not an improvement. When an old and well-tried system works tolerably well, change and experiments should be avoided. More time and further experience will furnish correctives far better than any which may be anticipated from a change of system and a displacement of those who have thus far given that system a claim upon the confidence of the country. That complaints, to some extent, have been made, is true; and that complaints would be made occasionally, under any mode of administration, is equally true; but, taking into account the magnitude of the establishment, the multiplicity of its details, and the large number of agents necessarily in its service, it seems to the committee that it merits no little commendation. In the opinion of the committee, a transfer of the duties of the Treasury Department, imposed by law in regard to our light-house establishment, is not called for by the public good.

The committee, however, have been instructed, by resolution, specifically to inquire whether the "light-house department ought not to be placed under the charge of the topographical bureau."

The construction of all our public works, up to 1838, was confided to the engineer corps of the Army. In that year (August 23) twelve of these works were transferred to the topographical corps. In 1839 (January 22) fifty-five were also transferred; and one, the Delaware breakwater, was transferred in June of that year. No appropriations of any consequence having been made for the prosecution of the public works since 1838, but little work has been done or money expended on them since that period, or since they have been placed in charge of the topographical bureau.

In what manner the administration of our public works will hereafter be conducted, (if indeed any further progress in them be authorized by Congress,) by the corps to which they have been transferred, remains to be seen.

If the same errors of calculation, want of economy, delays, and mismanagement, which characterized the proceedings of the old engineer corps, find place in the administration of the new, Congress should long hesitate before it consigned to its care any portion of the public works, and the vast expenditure of money attending their construction.

With a view of enabling the House to judge of the propriety of making the suggested transfer to the engineer corps, the committee
have prepared a statement of the estimates and expenditures of many of our public works. (Statement annexed, marked H.)

This statement should be taken in connection with or as a supplement to a report of the Committee of Ways and Means on the same subject. (See reports of Committees of the House, 1835-'36, vol. 1, No. 297.) A comparison of these estimates with the expenditures may suggest doubts whether light-houses or any other public works should be committed to the guardianship of men who, however scientific, seem to have wanted judgment, tact, and just notions of economy. It is to be hoped, if the old works are to be completed, or new works are to be commenced, that the topographical bureau may profit by the experience of their predecessors, and avoid their errors.

In a report recently made by this committee, in regard to the lighthouse on Flynn's knoll, &c., they referred briefly to the manner in which money had been expended on the public works, and spoke of what the country had a right to expect from their management, under the direction of the topographical bureau. When the prudence and efficiency of such management shall have been satisfactorily developed, it will be in time to consider the propriety of transferring to it the charge of our light-house establishment; until then, the committee are of opinion that the superintendence of that establishment should remain unchanged.

From the statement referred to, it appears that the original estimate of cost of twenty-three public works, was..................... $735,000 That the actual expenditure has been.............................. 2,382,000 And that the estimate to complete seventeen of them is..... 1,933,000 Showing that the expenditure exceeds the original estimate by more than 220 per cent; and that the expenditure and the estimates to complete, exceed the original estimates by more than 480 per cent.

The committee have referred to the estimates and expenditures on our public works, for the purpose merely of enabling the House to judge whether it would be proper to commit the light-house establishment to new hands.

The committee would cast no censure on the policy which prompted the construction of harbors, breakwaters, and clearing of rivers from obstructions. They have promoted, and will, under the fostering care of enlightened statesmen, continue to promote the great interests of commerce. They indulge the hope and belief that, whenever the condition of the public treasury will warrant the expenditure, our artificial harbors, on which so much money has been lavished, and nearly all of which are now fast going to ruin, will be permanently completed; and that new works in many portions of the country, imperiously demanded by the wants of navigation, will be thoroughly constructed. If any inducement were wanting, to hasten the pace of the patriot towards the goal of our real independence—an independence of foreign luxuries and foreign workshops—it may be found in the dilapidated condition of our public works, and in the pressing calls from many parts of the country for new safeguards to life and property, exposed, in the prosecution of doubtful voyages, to the fury of the elements on the ocean and the lakes. The committee believe it to be the part of wisdom to fill the
public treasury with money levied in the shape of a tax on the consumers of foreign produce and manufactures coming in competition with ours, sufficient for all the purposes of a prosperous commerce, of international communication, and national defence. Then protection (a word often used "to frighten men from their propriety") will mean something more than a mere temporary aid to domestic manufactures. By raising revenue in the manner and for the purposes indicated, our ships freighted with the rich products of our soil, will find protection in safe and commodious harbors and breakwaters, our national peace and honor will find protection in a well-appointed navy, in forts and steam batteries impervious to assaults, and our liberties will find protection in the hearts and hands of a contented and prosperous people, proud of a Government which devotes its energies to the development of the vast resources of the country, and to the advancement of national and individual wealth and happiness. But this, perhaps, may be considered foreign to the matter in hand. It is referred to for the purpose of preventing any inference of hostility, on the part of the committee, to our works of public improvement. They war not with the improvements, but with the manner and improvident expenditure of their construction.

MODE OF CONTRACTING FOR BUILDING—APPARATUS AND OIL.

Since 1816, all the light-houses and light-boats have been built by contract, invited by notice in the public prints. The contracts invariably have been given to the lowest bidder, having the ability to guarantee its performance. A suitable practical mechanic is employed to oversee the work constantly. Nothing is paid or advanced to the contractor until he obtains the certificate of the overseer, that the contract has been faithfully performed. In like manner, proposals for fitting up the light-houses with lamps, reflectors, &c., are invited, and the contracts given to the lowest bidder.

By this mode, competition is elicited, and, in the opinion of the committee, economy most effectually promoted. No losses can occur, as no advances are made until the completion of the work.

In the same way all the oil is procured. It is the interest of the contractor to furnish the best quality; for, if found bad, he not only gets no pay for it, but is bound to take it back, and substitute the best quality. Actual experiment by burning is the only true test of the quality of oil. The oleometer will not prove it. The practice now adopted of taking samples from each cask, and submitting them to the test of the lamp, cannot but insure the best quality. That oil congeals in cold weather is no proof of its badness. Oil pressed in winter, when the thermometer is at a given degree, will congeal whenever the thermometer falls below that degree. A stove and oil heater are the only remedies.

A vessel in the employ of the Department is constantly engaged in visiting the light-houses, supplying them with oil and other necessary supplies, and having on board a mechanic, to make all proper repairs to the lighting apparatus. Captain Howland, in 1840–'41, on board this vessel, visited one hundred and fifty-five light-houses, from Maine to the
Sabine, and put them in repair. As a proof that the oil furnished by
the contractors is good, he found but 600 gallons of oil in all of them
bad, and much of this was mere settlings.

It has been objected by some, who arraign the department for want
of economy, that the average consumption of oil in our light-houses is
less than that consumed in the British houses. This is no doubt true.
But the committee do not perceive the justness or consistency of the
rebuke, especially as it appears that our lights are more efficient than
those of Great Britain. It is said that the average annual consumption
of oil per lamp in England is forty-three gallons. From the accounts
given by Captain Howland, it does not exceed thirty gallons per lamp;
showing an economy in the use of oil of more than 43 per cent. over the
British lights.

As an evidence that an increased consumption of oil beyond a given
quantity does not add to the efficiency of the lights, the Cape Cod and
Cape Henlopen lights may be cited in contrast. (See paper annexed,
marked I.) The former was put up by Mr. I. W. P. Lewis, and con-
sumes sixty-eight gallons, each lamp, per annum. The latter, fitted up
by Winslow Lewis, consumes only thirty-three and a half gallons, each
lamp, per annum.

It is understood that the Cape Henlopen light is as efficient as that at
Cape Cod, notwithstanding this great disparity in the consumption of oil.
A greater elevation of wick, accompanied with a current of air, on the
principle of the carcel lamp, produces this increased consumption of oil.
But experiment has shown that no corresponding advantage of increased
range of light is the consequence.

EXAMINATION—LIGHT-HOUSE ESTABLISHMENT.

Letter from the Secretary of the Treasury, transmitting a report from
I. W. P. Lewis, civil engineer, upon the condition of the light-houses,
beacons, buoys, and navigation, upon the coasts of Maine, New Hamp-
shire, and Massachusetts.

February 25, 1843.—Read, and laid upon the table.

Treasury Department, February 24, 1843.

Sir: I have the honor to transmit, herewith, in compliance with the
resolution of the House of Representatives of the 23d of December last,
the report of I. W. P. Lewis, civil engineer, on the examination of the
Light-house Establishment of the United States so far as it has pro-
gressed, and which comprehends the description of seventy establishments
in the States of Maine, New Hampshire, and Massachusetts, being one-
third of all the lights on the seaboard, and also the correspondence
relative to this examination.

The Light-house Establishment having become a prominent branch of
expenditure committed to the supervision of this Department, my attention was arrested by an examination of the annual cost of maintenance, and the very large increase of expenditure devoted to this object for several years past. Believing that there must be some defect in the system of building, and that the large sums annually required for repairs pointed to such a cause, it was deemed proper to institute a special survey and examination, for the future guidance of this Department.

The points on which the Department required information are expressed in the letter of instructions to Mr. Lewis, to which the attention of the House is respectfully requested.

Impressed with the value of our Light-house Establishment, in its intimate connection with the safety and security of commerce, and of the revenues dependent thereon, and believing that a greater degree of system in its details, and economy in its administration, are demanded by the public interests, I have to submit to the consideration of Congress the following suggestions, with the fullest confidence in their importance and necessity:

1st. That no appropriation shall be made hereafter, for the erection of a new light-house, until the necessity of such a light shall have been ascertained by a competent engineer, who shall report to the Secretary of the Treasury the necessity of establishing the light petitioned for, the proper site to be selected, and a suitable plan, estimate, and specification, of the required buildings; also detailing the magnitude of the light required, and its distinctive character, with a view to render it intelligible to seamen, if established—all of which shall be submitted to Congress, for such action as may be then deemed proper.

2d. Whenever the repairs of light-house buildings or floating lights called for exceed in amount $500, the nature and extent of such repairs, and the probable cost thereof, shall be carefully estimated and reported to the Secretary of the Treasury by said engineer before they shall be authorized. All expenditures under the sum of $500 shall be made as here-tofore. Contracts shall be made where the expenditure for the construction or repairs of land and floating lights exceed the sum of $500, which contracts shall be subject to the approval of the Secretary of the Treasury, and be filed in the office of the First Comptroller of the Treasury.

3d. The system of illumination, and whatever is connected with the lighting apparatus, shall be placed under the supervision of the said engineer, who shall in all cases report to the Secretary of the Treasury the alterations or improvements, if any, which may be required. Such report to be approved before any alterations or improvements shall be authorized.

To the attainment of these purposes, it is proper that the Secretary of the Treasury be empowered to select and appoint a competent scientific and practical engineer, whose whole time shall be devoted to the regulation of the details of the light-house system, as set forth, and who shall report to this Department, at the commencement of every session of Congress, to be communicated by the Secretary of the Treasury to Congress, the actual condition of the Light-house Establishment, its wants for the coming year, with detailed estimates, and such other infor-
mation as comes within the scope of his duties—the salary of said engi-
neer to be not less than $3,000 per annum.

It may be proper here to remark, that, on referring to prior acts of
Congress appropriating moneys for a scientific examination of the Light-
house Establishment, it will appear that, under the 2d section of the act
of the 3d of March, 1837, (Laws U. S., vol. 9, p. 653,) entitled "An
act making appropriations for building light-houses, light-boats, beacon-
lights, buoys, and dolphins, for the year 1837," before any of the im-
provements in said act were to be commenced, the Board of Navy Commis-
sioners were to cause an examination to be made, for the purpose of
ascertaining whether the safety of navigation required any additional
facilities, and to report to the Secretary of the Treasury, who would
proceed with such improvements as they should report as necessary.

In the Treasury estimate for the year 1838, for the support of the
Light-house Establishment, the following item was for the first time
inserted: "For expense of a board of Navy officers in examining and
reporting the condition of all the light-houses annually, in addition to
examinations already provided for, $4,000." The amount of the estimate
for the Light-house Establishment for that year was $356,863, and
that sum was appropriated in the usual form of such appropriations, and
including said $4,000, as follows: "For the support and maintenance of
light-houses, floating lights, beacons, buoys, and stakages, including the
purchase of lamps, oil, keepers' salaries, repairs, improvements, and
contingent expenses, $356,863." Subsequent estimates have included
in the items for the support of the light-house establishment the sum of
$4,000, which has been inserted in those estimates in these words, viz:
"For expense of examining and reporting the condition of all the light-
houses, $4,000." And, although this duty was no longer assigned to
naval officers, no reason has been discovered for the discontinuance of
this annual examination by scientific agents selected for the purpose.
In regard to the authority under which this examination was instituted,
I have to refer to the acts of Congress above cited, and to the opinion
of the Attorney General, herewith transmitted, which was obtained in
consequence of the powers of the Secretary of the Treasury to institute
such survey having been questioned shortly after the appointment of
Mr. Lewis.

Accompanying this report will be found testimonials as to the qualifi-
cations of Mr. Lewis, and his fitness for the service to which he was
appointed. It will be for Congress to decide whether the report itself
does not justify the confidence which has been reposed in him.

The payments for the expenses of this survey have been made out of
the following appropriation: "For examining and reporting the condi-
tion of all light-houses, annually, $4,000," as is shown by the letter of
the Comptroller of the Treasury, herewith transmitted, dated the 17th
January last. The expense of said survey has been $3,672 60½ cents,
which includes the sum of $462 08, paid on account of the vessel
employed in the survey.

The value of the information already obtained in the examination
made by Mr. Lewis leads to the belief that the public advantage and
the interests of our commerce will be materially subserved by its continuance.

In the expenditure of the large sum now annually required for the maintenance of this establishment, so widely spread along the sea-coasts and lakes of the United States, unaided by the science and skill now sought to be obtained and secured, it has been found impossible to guard against all abuses. These necessarily result from the existing defects in the system, and must not be readily imputed to mismanagement of the Department; and it is believed, if the necessary provisions be made by law for the improvements now suggested, the light-house establishment of the United States will be made much more efficient, and with every probability of a diminution of the cost of its annual support and maintenance.

All which is respectfully submitted.

W. FORWARD,
Secretary of the Treasury.

Hon. John White,
Speaker of the House of Representatives.

WASHINGTON, January 31, 1843.

SIR: I have the honor to submit the accompanying report of my examination of the light-houses, &c., on the coast of Maine, New Hampshire, and Massachusetts, being that portion of the general survey of the light-houses, beacons, and buoys of the United States, effected prior to the 11th of October last, according to your orders dated May 25, 1842.

The number of establishments already visited is 70, comprehending 79 light-houses and beacon-lights, one floating light, and a great number of sea-marks, or beacons, and buoys. The actual condition of each establishment is particularly stated under their respective names, and appended hereto.

The general statement annexed gives a condensed account of the results of the survey, so far as completed, and the numerous defects of the methods of "construction" and "illumination," are detailed at length under those heads. The evidence of the keepers as to the condition of the buildings and public property under their charge, as also the opinions and testimony of several respectable individuals, upon the methods of construction hitherto used, will be found appended, together with such information respecting the wants of navigation in the lighting and buoyage of the coast as could be collected.

Astronomical observations for latitude and longitude were taken at every place visited, when the state of the weather admitted, the results of which will be found in the catalogue of lights. The remarkable errors of position now assigned to some of the most important points on the best charts extant of the coast of Maine will account for many of the wrecks that occur there, when the necessity of a complete trigonometrical and hydrographical survey is being felt more sensibly every year.
I take this opportunity to testify my obligations to Messrs. E. & G. W. Blunt, of New York, who in the most liberal manner supplied me, gratuitously, with a number of costly astronomical instruments that I could not have obtained from any other source, and by means of which the above-mentioned observations were taken.

The recent appointment of the several superintendents of lights prevented the obtaining of accurate information as to the amounts annually expended in repairs upon the several light-houses, this item being essentially important to demonstrate the rapid decay of those buildings erected by faithless contractors, and the necessity of a more permanent mode of construction. We have had no legislation upon the subject of light-house construction since 1789, when the present law of erecting by contract was enacted, and at which time there were but eight light-houses on the coast of the United States. The number has now increased to 286, including 30 floating lights, requiring for their support an annual appropriation of nearly half a million of dollars. While the present administration of this immense establishment is one of usage, the mere result of accumulating wants, and without one wholesome legal check or provision to economize the expenditures, or reduce this unhealthy growth to anything like system; while France and Great Britain have called in the aid of their most eminent scientific men to improve the construction and illumination of their coast lights, the establishment of this country has languished under the rule of ignorant and avaricious contractors, unrestrained by any law or other influences requisite to the proper government of so important a branch of public service.

It is to the want of such laws, as well as the absence of an active supervision of the details of the service, that we directly trace the present disordered and inefficient condition of the establishment, as will be shown whenever the subject is fairly investigated, and the truth obtained. I would state, in conclusion, in obedience to the 3d clause of your orders, that the Government land and buildings, at each establishment visited, were carefully surveyed and measured, but the labor required to reduce the notes of the surveys to drawings has not yet been in my power to perform.

I have the honor to be, with great consideration and respect, your most obedient servant,

I. W. P. LEWIS, Civil Engineer.

Hon. Walter Forward.
Secretary of the Treasury.

INSTRUCTIONS.

Treasury Department, May 25, 1842.

Sir: Being desirous of obtaining a careful and accurate survey of the present condition of the light-house establishment, you are hereby appointed an agent to visit the several light-houses, and to make an examination of the positions now occupied, and of the floating lights,
beacons, and buoys, and to report to this Department generally, and in particular upon the following points, viz:  
1. The present state of repairs of buildings, (required.)  
2. Condition of the lanterns and apparatus, and number of lamps.  
3. Description of each locality and measurement of the premises.  
4. Height of the lantern above tide level, and reach of the light.  
5. Upon supernumerary lights and deficient lights.  
6. Condition of floating lights, height of lamps above the sea, and distance at which they can be seen.  
7. Description of each locality, in the view to the erection of permanent light-houses in place of floating lights.  
8. Condition and structure of beacons.  
9. A thorough examination of the buoyage.

From these data you will please draw up a report comprehending—  
1. A complete system of illumination of the whole coast of the United States.  
2. The classification of existing lights into four classes, according to relative importance.  
3. A complete system of beaconage and buoyage.

Every information bearing upon any of the foregoing points you are to collect and report to this Department, with tabular statements of the annual expenses of the establishment; and you are hereby authorized to call upon the superintendents of light-houses, and revenue officers generally, for such accounts, vouchers, and statistics, as shall be required by you in the performance of this duty.

You are particularly directed to ascertain the nature and extent of all repairs, whether of buildings or apparatus, which are requisite to be made, and communicate the same to the superintendent of light-houses, with such suggestions as may best enable him to direct the repairs to be made with the best advantage and permanent benefit to the light-house establishment.

Whenever any important facts are discovered relating to the light-house service, you will obtain proper evidence of such facts, accompanied with affidavits if necessary.

I have given directions to the different superintendents of light-houses, and commanders of revenue cutters, to give you all the aid in their power in performing these duties, as you will perceive by the enclosed letters, which you will show when you shall require their services.

If it shall become necessary to hire boats or other conveyance for the purposes of examination or survey, you will hire such boat or conveyance at a reasonable rate; and in all cases take vouchers specifying every particular of the expenses incurred.

The cutter Rush has been specially detailed for this service, and the collector at New York is notified to prepare that vessel for the duty, as per copy of his instructions enclosed herewith.

With great respect, your obedient servant,  

W. FORWARD.

I. W. P. LEWIS, Esq.,  
Boston, Massachusetts.
Circular to Collectors of the Customs and Superintendents of Light-houses.

TREASURY DEPARTMENT, May 25, 1842.

I have appointed the bearer hereof, I. W. P. Lewis, Esq., to make a careful examination of the lights, beacons, and buoys, of the United States, and to obtain such information upon these subjects as this Department has required of him; and you are therefore requested to extend to Mr. Lewis every aid in the prosecution of his duties, and furnish him with copies of any accounts of expenditures upon light-houses, &c., in your district, which he may deem necessary for the illustration of his report.

Very respectfully, your obedient servant,

W. FORWARD,
Secretary of the Treasury.

TREASURY DEPARTMENT, May 25, 1842.

SIR: I have appointed I. W. P. Lewis, Esq., to make a careful examination of the light-houses, beacons, and buoys, of the United States, and to obtain such information upon these subjects as is required by this Department. I have detailed the cutter Rush, now stationed in your district, for this service; and you will therefore cause this vessel to be victualled for a cruise of six months, and her crew re-shipped for the same period, placing her under command of some experienced seaman, who will receive Mr. Lewis and his assistants on board, and convey them to such points of the coast as the instructions of this Department to Mr. Lewis require.

Very respectfully, your obedient servant,

W. FORWARD,
Secretary of the Treasury.

EDWARD CURTIS, Esq.,
Collector, New York.

Report of I. W. P. Lewis, Civil Engineer, made by order of Hon. W. Forward, Secretary of the Treasury, on the condition of the light-houses, beacons, buoys, and navigation, upon the coasts of Maine, New Hampshire, and Massachusetts, in 1842.

GENERAL STATEMENT

As to the navigation and present condition of the light-houses, beacons, and buoys, upon the coasts of Maine, New Hampshire, and Massachusetts.

The shores of Maine are different from any other portion of the United States, in the peculiarity of conformation produced by innumerable indents and deep bays, filled with immense groups of rocky islets. This sinuosity of outline, together with the size, number, and grouping
of the islands, form harbors of every shape and magnitude, from the superb inland basin at Mount Desert, where our whole navy can moor in perfect security, to the snug harbor of Little river, so convenient for the coaster bound in or out of the Bay of Fundy, when met with head winds or tides.

Deep safe channels abound within the exterior islands, and all small craft acquainted with the navigation avail themselves of the smooth water and continual succession of safe harbors offered by this in-shore water. Fogs of uncommon density are frequent and of long duration on this coast, often suspending all navigation for a week or more. The great rise of tides, and consequent rapidity of currents, also present difficulties to the seaman; but the greatest danger arises from the host of sunken ledges that everywhere abound, in the midst of the largest bays, in the narrowest channels, or off shore at the distance of some miles. The entire coast of Maine being a rock formation, the soundings are deep and irregular, the approaches abrupt, the use of the lead little resorted to, and by no means a safe guide, as on the gradually sloping bottom of Massachusetts bay and our southern coast. Hence, the necessity of lights, beacons, and buoys, of the most efficient character, as well as charts of undoubted accuracy. The commerce of Maine is now sufficiently important to require every aid and facility to navigation that can be obtained. Her tonnage already ranks next in amount to Massachusetts and New York, and her hardy seamen have more dangers to contend against in approaching these shores than on any other portion of our seaboard.

It is three-quarters of a century since the British surveyor (De Barres) produced his chart of the coast of Maine, which remains to this day the basis of the only one known possessing even a remote approximation to accuracy. This chart, the result of a mere reconnaissance, effected with imperfect instruments, and a rapid series of operations, is so erroneous as to cause the most fatal disasters. Wrecks are continually occurring from the false positions assigned to important points, and the more prominent islands outlying the coast.

As the foreign commerce of Maine increases, so will the annual loss of lives and property; for strangers must rely upon the chart of De Barres, while the coasting trade make use of their local knowledge, or feel their way from one point to another. The British timber and emigrant ships that are bound into the Bay of Fundy are the class of vessels that suffer most, as the number of wrecks between Petit Menan light and West Quoddy head, on the opposite shores of Grand Manan, sufficiently prove. It is natural to suppose that the dangers of navigating the coast of Maine would have attracted the particular attention of our Government, and every means be taken to prevent suffering and loss of property, by improving to the highest perfection the light-houses, fog-bells, beacons, and buoys. Such, however, is far from being the case. The light-houses, as a whole, are inferior in their arrangements and effects to the beacon-lights of Long Island sound or Chesapeake bay. Among the whole number (thirty-one) there is not one that equals in brilliancy the harbor beacon at Stonington. Everything like systematic arrangement is utterly unknown; obscure inland beacons have more lamps than ex-
terior lights of the highest importance. None of the great coast lights have more than ten lamps, except those near Portland, which have but fifteen. The beacon-light on the Penobscot river has as many lamps, and much larger and better reflectors, than the great coast light of Petit Manan, where three wrecks have occurred since the period of this examination, one of which was insured at Boston for $10,000.

As a rule of universal application to the light-houses of this coast, resulting from careful observation in clear weather, it may be stated that the towers can be seen further by day than can the lights they respectively bear by night.

In the structure of the lanterns and fitting up of the illuminating apparatus, all established rules and principles governing the subject are set at defiance, as the notes of survey will prove to every impartial mind.

The beacons or sea-marks are very few in number, considering the nature of the navigation, and might be multiplied with great advantage, if located upon some of the numerous exterior ledges that render the bay and island channels so very dangerous. Many of the existing beacons are located in close harbors, where they are of but little use, while there are but four on the entire coast of Maine that occupy exterior positions; and the same remarks apply to the buoyage of these waters. There are buoys in abundance on Kennebec river and in the snug harbors of Portsmouth, Portland, Thomaston, &c., but on the immense number of outlying rocks and dangers there are none whatever; not one buoy, beacon, or spindle to be seen in the whole navigation of Penobscot bay. More than 10,000 sail of merchantmen pass annually through the Muscle Ledge passage, entering or leaving this bay, according to the record kept by the keeper of Whitehead Island light, and this channel being notoriously dangerous, the utmost care is observed, by those who enter it, to avoid the sunken rocks and ledges, notwithstanding which, every day, almost, vessels are seen hard and fast upon one or other of these dangers.

The liberal appropriations made by Congress to multiply the number of light-houses, beacons, and buoys, and thereby increase the facilities of navigation on this coast, have been too often misapplied by those intrusted with the expenditures, and local interests are subserved, while the public still remain sufferers. It is very well for those who are totally ignorant of navigation in its simplest form, those whose limit of experience is not beyond the scope of a steamboat cruise in smooth water, to declaim about the superior character, economy, and efficiency of our Light-house Establishment. Those practically acquainted with its defects, those who have felt the horrors of shipwreck, or know by sad experience the difficulties and dangers of navigation, even under the most favorable circumstances, seem to be of opinion that our Light-house Establishment is susceptible of some improvement, and that beacons and buoys may be multiplied, to the immediate benefit and advantage of commerce. The mere arrangement of distinguishing lights on the coast of Maine will prove that there is neither knowledge of the wants of navigation, nor any attempt made to ascertain those wants.

It will be seen that the recurrence of distinctive lights must necessarily be rare, as there are only four in number that can properly claim
that rank, and the intervening coast has lights precisely similar to each other. From Monheigan island, seven fixed lights are visible at one view.

The fatal mistakes produced by this absence of all system are of frequent occurrence, and the wrecks numerous, and generally of a fatal character. All the lights in Penobscot bay are fixed lights, and the only four revolving lights on the coast of Maine are so badly fitted up that they frequently stop in their rotations, and become fixed lights in effect, though visible only in two directions, and leaving to darkness and astonishment the unfortunate navigators who occupy the two opposite directions, or dead angles.

The benefit that would be conferred on navigation by adding to the number of revolving lights, fitted with substantial machinery to insure their constant operation, will be best understood by stating the simple fact that a revolving light can be made of tenfold the brilliancy and effect of any fixed light without using a greater number of lamps and reflectors. For example, a fixed light intended to illuminate the entire circle of the horizon, as when located upon an island like Mount Desert Rock, requires twenty four lamps and reflectors, which being arranged upon a horizontal circle, it is evident only one can be seen at a time by the observer, who shall sail around the island. Convert this light into a revolving one, by placing 12 lamps and the reflectors on opposite sides of a revolving frame, the combined effect of the twelve reflectors is presented to view instead of one, as in the fixed light. Reduce the lamps of the revolving light to six, three in each face of the rotator, and you have the combined effect of the three reflectors instead of one, as in the fixed light, and a saving of 75 per cent. in maintenance.

The French government have fourteen revolving lights on their ocean district, whose linear extent is much less than that of Maine. The English government have nine revolving lights in the English channel, and eleven in the Irish channel. The Scotch have eleven revolving out of twenty-two coast lights. The French make use of no colors to distinguish their lights, because it involves a great diminution of effect; but the duration of light and darkness is varied sufficiently to enable any seaman to know one light-house from another. In Great Britain there are nine distinctive characters used in their light-houses, while we have but three.

The navigation of the waters of Massachusetts present fewer difficulties to the careful seamen than those of Maine. The free use of the lead will warn of approaching danger, and the prevalence of fog is less obstructive to safe movement than amidst the ledges and rocks of the Eastern coast. The approach to Boston is, however, very difficult in thick weather, more particularly if neither Cape Ann nor Cape Cod lights have been sighted for a departure—these being the two salient points of the bay, and Boston light-house occupying the apex. The depth of the bay is between forty and fifty miles. Ships entering with a northeast gale, if they fail of hitting the light-house channel by drifting to the southward, are often wrecked on the lee shore of Cohasset, where a dangerous reef extends about two miles to the northward, and is annually the scene of most heart-rending disasters. For a long series of years, petitions have been presented to Congress, from the citizens of Boston,
for erecting a light-house on these dreadful rocks, but no action has ever yet been taken upon the subject. One of the causes of frequent shipwrecks on these rocks has been the light-house at Scituate, four miles to leeward of the reef, which has been repeatedly mistaken for Boston light, and thus caused the death of many a brave seaman and the loss of large amounts of property. Not a winter passes without one or more of these fearful accidents occurring. Notwithstanding this fact of the mistaken location of Scituate light (which is of no local importance whatever, standing at the entrance of an obscure harbor, which is dry at low water, and at high water, spring tides, only admits a draught of eight feet) has been notoriously public for years, and nine out of ten of the wrecks on Cohasset rocks attributed to its evil influence; still no report upon this subject has ever been made to Congress by the superintendent; but, on the contrary, the establishment has recently been refitted in a most extravagant manner, with as many lamps as the great coast light on Cape Cod. One of the most interesting objects of this inspection was to ascertain the feasibility of erecting a light-house on the extremity of the Cohasset reef; and it was found that, though formidable difficulties would embarrass the undertaking, still they were not greater than such as were successfully triumphed over by a "Smeaton" or a "Stevenson."

The number of wrecks in Massachusetts bay, between Nantucket shoals and Plum Island lights, as collected from the files of the Boston Daily Advertiser, is given below, though this list is not by any means complete: Square-rigged vessels, 110; schooners and sloops, 306—total of wrecks in nine years, as far as ascertained. 416.

The amount paid by the Boston insurance offices on such of the above wrecks as were "total losses" was $770,650; and probably as much more was paid by the New York offices. The following is a list of wrecks that have occurred on Cohasset reef and its immediate neighborhood during the last nine years, as obtained from the files of the Boston Daily Advertiser; and, though it is necessarily incomplete, will yet give some idea of the dreadful calamities occasioned by the want of a light-house here, and the mistakes produced by the location of Scituate light:

1833. February. Schooner Mechanic, from Baltimore, for Salem; all hands perished.

November. Schooner Ospray, from Philadelphia, for Boston; total loss.

1834. January. Schooner Barb, from Halifax, for Boston; sunk near Scituate.

April. Brig Attila, from Rio, for Boston; ashore on rocks near Scituate.

May. Sloop Parker, from Providence, for Boston; struck on Harding's ledge, and sunk.

November. Brig George Loyal, from Norfolk, for Boston; ashore on Cohasset beach.

November. Schooner Sir H. Douglas, from Windsor, for Boston; ashore on Scituate beach.

1835. January. Brig Francis, from St. Mark's, for Boston; ashore at Scituate bar.

January. Schooner Optic, from New York, for Thomaston; lost.

1886. January. Brig Juno, from Cronstadt, for Boston; Cohasset rocks; total loss.
January. Brig Banner, from Savannah, for Boston; Cohasset rocks; total loss.
April. Sloop Alexander, from Wareham, for Boston; Cohasset rocks; crew lost.
June. Brig Globe, from Malaga, for Boston; Cohasset rocks; crew lost.
July. A large schooner, name unknown, struck on Cohasset rocks, and lost.
October. Brig Forest, from Norfolk, for Boston; ashore on Cohasset rocks.

February. Schooner Spencer, ashore on Scituate beach; a total loss.
February. Brig Trio, of Portland, lost on Cohasset rocks; officers drowned.

1888. April. Brig William Harris, totally lost on Cohasset rocks.
August. Schooner Sappho, struck, and lost on Cohasset rocks.
September. A schooner lost on Cohasset rocks during the gale.
November. Brig Charles Wells, totally lost on Cohasset rocks during the gale.

1888. December. Schooner Margaret, ashore on Cohasset rocks.

1889. December. Bark Lloyd, totally lost on Nantucket rocks; nine drowned.
December. Schooner Charlotte, ashore on Nantucket rocks.

1840. April. A brig and crew totally lost on Cohasset rocks.
November. Schooner Delaware, stranded on Scituate beach, having mistaken Scituate for Boston light.
December. Schooner Perse, run ashore on Scituate bar, having mistaken the light for Boston.

1841. February. Brig Bordeaux, lost on Cohasset rocks.
March. Bark Arab, lost on Cohasset rocks.
April. Sloop Warsaw, totally lost on Cohasset rocks.
June. Brig Russia, totally lost on Cohasset rocks.
August. Pilot-boat Boston, struck on Harding's ledge, and filled.
October. Schooner Maine, lost on the Scituate rocks.
November. Brig Constantia, lost near the Scituate cliffs.
December. Anawan, struck on Harding's ledge.

This list includes some losses on the rocks and shores lying both north and south of Minot's ledge, on Cohasset rocks; and these losses are enumerated because the establishment of a light on this ledge would
probably prevent the recurrence of such accidents, by warning vessels of their approach to danger, or enabling them to pass inside the reef and anchor, in case of necessity. A very eligible "harbor of refuge" might be formed, at a moderate cost, by constructing a continuous breakwater from one dry ledge to another, on the north elbow of the reef; and also on the southern side—the intermediate space being a deep and capacious basin, with a channel entrance of from three to seven fathoms of water. This suggestion is merely thrown out in the hope of drawing attention to so important a subject.

There is another still more fatal spot upon the coast of Massachusetts, where many a brave heart and many a gallant ship lie buried in one common grave. The shoals of Nantucket are known and dreaded by every navigator on the Atlantic seaboard, and among the great number of "missing vessels" recorded at the insurance offices, there are doubtless many that have been swallowed up in these treacherous quicksands. The South shoal of Nantucket is supposed to be situated at about twelve miles distant from the extreme southern part of Nantucket island. Its exact position, however, remains to be determined, and will probably be found to be somewhat nearer the island than is now generally stated. Its bearing from Sancoty head, per compass, is south by east. In addition to the South shoal are several others, equally dangerous to large vessels, (viz, Bass rip, Great rip, and Fishing rip,) lying nearly parallel to each other, and east of Sancoty head, at the distances of three, twelve, and twenty-four miles from the island; while southwest of said head lies another smaller shoal, called the Old Man; and one also makes off from the island, at its southeast extremity, called Podrick Rip. An accurate and detailed hydrographical survey of all these shoals, as also of numerous others lying north of the same island, is of vital importance to our foreign and coasting navigation, and the establishment of screw-pile beacons on all or most of them would be attended with the most beneficial results. A more important measure, however, is the erection of a first-class light-house upon the highlands near Siasconset, and it is really very remarkable that this most striking omission in the lighting of our sea-coast has not before been observed. By establishing a powerful light on the southeastern elbow of Nantucket island, all the vessels that now feel their dubious way around the South shoal, and between the rips, to the eastward, could coast the south shore of the island, and pass between Sancoty head and Bass rip in a safe deep channel, avoiding all the dangers and uncertainties of the outer track. It is the common practice of navigators, bound from southern ports to Boston or other places in Massachusetts bay, to run into the Vineyard sound, and lie up at Holmes's hole, or Edgartown harbor, causing their owners great loss and inconvenience, from the delay attending this movement; for vessels are often obliged to lie, wind or ice bound, in these two harbors for many days, when, if sure of a safe passage inside Nantucket shoals, they could have kept on their course, and thus shorten the voyage, besides diminishing the risk of the outer or inner passage. If screw-pile beacons were erected upon the northern and southern extremities of the South shoal, Bass rip, Great rip, and one upon the Old Man, the navigation "over the shoals" would become as safe as on any part of our coast, while the
establishment of a light-house at Siasconset would be more generally useful to the commerce of the United States than any other position on the seaboard.

At present there is no mark upon any of these shoals, save what a merciful Providence has, by a law of nature, rendered eternally useful to man. The rapidity of the tides, which sweep along the sides and over the uneven surfaces of these shoals, causes what are termed tide rips, which are in effect breakers running confusedly together, and sometimes of such a magnitude as to be dangerous even to large vessels. Nothing can be more terrific and grand in appearance than the pyramids of foam that are piled up on the South shoal of Nantucket, after an easterly storm. It is these “rips” alone that now serve to warn the navigator of his approach to danger. The feasibility of erecting screw-pile beacons on these shoals will hardly be questioned, with the example of England before us, who has succeeded, during the last few years, in obtaining a firm foundation upon similar shoals, previously considered impracticable for any work of human hands.

Some improvements in the brilliancy of the lights have been effected on the coast of Massachusetts, but this is confined to Boston bay, the remaining portion being in a similar condition to the light-houses of Maine. The same errors of construction and design, the same ignorance of the application of artificial light, is visible amongst all. In those light-houses refitted at a great cost, with enormous lanterns of plate glass, and reflectors of a large size, (from which two elements it seems to have been supposed a great increase of light was to be obtained,) the original and vital errors still remain.

The arrangement of distinguishing lights on the coast of Massachusetts is no better than that of Maine. For example, we commence at Newburyport with a double fixed light, and, proceeding nine miles south, we have a second double light at Ipswich; within the next nine miles we have two fixed lights and another double fixed light; proceeding southwest ten miles, we have two fixed lights and yet another double fixed light. Here it will be seen, within the space of thirty miles, there are four double lights and four fixed lights. The number of lamps in the small harbor beacons is the same as in the great coast lights—as, for example, Marblehead and Gloucester Harbor beacons have each within one lamp as many (10) as Cape Ann, (11,) and Salem harbor light has four more than the latter, (15,) On the south shore the same error exists—Scituate light, presiding over an obscure tide harbor, has one more lamp than Boston light, (14,) at the entrance of the most important harbor in New England. Provincetown Harbor beacon (10) has two more lamps than the great coast light at Monomoy, (8,) and so on throughout the district.

The evils arising from this error, in omitting to graduate the power of the light according to its location, are not confined to the mere wasteful expenditure occasioned by burning and maintaining in repair so many more lamps than are necessary, but a far worse result ensues, particularly when several lights are grouped about in one neighborhood, where all appear precisely of the same magnitude; and it becomes impossible for the navigator to distinguish amongst the number the exact
one for which he is seeking, and before solving the dilemma he may lose his life and property in one common wreck.

The arrangement of lights on Cape Cod is singular enough. Beginning at Truro, which is a fixed light, we have next at Nauset a triple light, or three light-houses in a row; next, at Chatham, are two more lights, at Monomoy one, and Nantucket one—all being fixed lights.

The lights in the Vineyard sound are twelve in number, and all fixed lights, excepting Gay Head, which is a revolving one. The next revolving light occurs at the head of Buzzard’s bay, where the navigation is limited to a few small craft, and where a distinguishing light is least required—all the remaining lights in this bay, five in number, being fixed lights. Thus, among the thirty-eight light-houses on the coast of Massachusetts, we have but five revolving lights; of the remainder, eight are double lights, one a triple light, and twenty-five fixed lights.

Of the seventy-one light-houses included within the limits of this survey, only ten are revolving lights, and but six of this number are coast lights.

Seven hundred and eighty-one lamps are now burning in these seventy-one light-houses. If each light were brought to its proper magnitude, without altering their present distinctive characters, there would be a reduction of 235 lamps; which, at the present rate of maintenance, would be a saving of $11,750 annually. But if the coast under consideration were illuminated upon a systematic plan, as expressed in the annexed schedule, which contains six new light-houses, required to render the illumination of the coast complete, where no two lights of the same character occur within such distances of each other as to produce mistakes, the reduction in the number of lamps would be then 405, and an annual saving of $20,000 effected.

The numerous alterations required to obtain the distinctive lights set forth in the annexed schedule will of course be met with the usual and very proper objection, that the alteration of the character of a light, at any time, must always be attended with danger to those navigators who have not been duly informed of the change. Formidable and true as this objection really is, yet it is not by any means insuperable. The whole of the great coast lights of France have been thus altered and essentially improved within a few years past, according to the plan of distinction and classification reported in 1825 by Admiral De Roessel. Lights have been heretofore altered on our coast, without any warning whatever to the maritime public, other than publishing the fact when such alteration was actually effected. The light-house at Mobile was altered from a fixed to a revolving one, and this, too, without the knowledge of the Fifth Auditor, and upon the sole responsibility of the contractor. The next light east of it, and about 40 miles distant, being a revolving light, the similarity of appearance, and the absence of any warning whatever, produced several serious mistakes. (See Doc. 135, 25th Cong., 2d sess., pp. 6, 8.) When the two lights at Navesink were altered, and the lenticular apparatus put in operation, no notice was given to the public, describing the characteristic appearance of these lights, so different from all others on our coast. Lights are extinguished for repairs at two-days’ notice, a recent instance of which occurred at New-
buryport, and, when first relighted, the lamps and reflectors were faced
towards the town, for the amusement and gratification of the inhabitants.
No coast light should be altered without six-months' notice, published
in all the leading journals of the day, and the information further ex-
tended by means of handbills, to be issued at all the custom-houses.
The same rule applies quite as forcibly to the establishment of any new
light-house, beacon, buoy, or floating light. Such a wholesome regula-
tion is, however, unknown to the light-house service of this country;
while in Great Britain, France, and all European maritime nations, it is
most strictly observed, not only in stating the fact simply, but also every
particular connected with it, such as the color, times of revolution, or
other characteristic of the light, with its compass bearing from all promi-
ncient objects in the vicinity, its limit of visibility, its particular uses to
the local navigation, &c.; and the same formula is observed in respect
to beacons, buoys, and floating lights. Hardly a month passes, that we
do not see one or more of these notices of foreign lights, &c., republished
in our newspapers by official agents resident in this country.

* * * * * * * * * *

But we must avail ourselves of the improvements adopted for many
years past in Europe, and which have not only stood the test of long
experience without fault, but raised the character of the French lights
above all others. An examination of Doc. No. 274, 27th Congress, 2d
session, will satisfy every one of the nature of the French system, and
the great care that is taken to insure the faithful performance of the
contracts. It is proved by this document that the entire Light-house
Establishment of France, embracing the channel, ocean, and Mediterra-
nean coasts, and illuminated by 119 light-houses arranged in four dis-
inct classes, according to their local importance, is maintained at an
annual expense of 355,446.45 francs, which, allowing 19 cents to the
franc, is but $67,584 77. This is an official document, emanating from
the chief engineer of the Light-house Administration, and the transla-
tion of it transmitted to Congress by the Fifth Auditor, who complains
that the item of repairs (which he admits constitutes "one-half of the
expense of our establishment") is entirely omitted. By reference to
the document, it will be seen that this statement of the Fifth Auditor
is erroneous. On page 3 will be found a schedule, forming the basis of
the contracts, and articles 3, 4, 5, 6, 7, and 8, apply exclusively to
repairs, and the succeeding pages give the details of repairs required
at the expense of the contractor. The reason that the repairs of French
light-houses form so small an item is, that they are designed by and con-
structed under the direction of architects and engineers whose education
fits them for the execution of such works. If the French government
intrusted the construction of their light-houses to contractors, as has for
many years past been the case in this country, it is more than probable
the item of repairs would exceed the entire sum paid now for complete
maintenance.

The radical cause of the present defective condition of our Light-
house Establishment seems to be found in the law of 1789, which pro-
vides for the erection and construction of all light-houses, beacons, and
buoys, by contract with the lowest bidder whose qualifications or respon-
sibilities are unquestioned, "provided he can give bonds for the execution of the work." But the same law (and it is the only one bearing upon the subject) omits to provide for the examination of the site, or the preparation of a design of construction suited to such site, whatever may be its peculiarities. It omits, in short, every wholesome regulation calculated to confine the cupidity of contractors within the bounds of honesty; and the nation has thus been encumbered with a family of 250 light-houses, all more or less defective, and all crying out for continual repairs. For many years past, the specifications describing the construction and material to be used in erecting new light-houses have been prepared by a contractor, who, in most cases, has been the successful bidder, and has erected upwards of one hundred different establishments. The simple fact that a contractor should thus perform duties that are strictly "official," or at least ought to be so, prevents any honorable man of reputation and professional skill from becoming a bidder, knowing, as he must, that such a practice effectually destroys all competition. This fact also accounts for the striking family likeness amongst all the various establishments, no matter how opposite the character of their locations. Be it the rocks of Maine, the sands of the Carolinas, or the mud banks of Louisiana, the same formula of construction is observed throughout. When the repairs of the Light-house Establishment are officially admitted to be nearly one-half the annual cost of maintenance, it is a sufficient proof that the construction has been of a defective character. The evidence embodied in this report will show that frauds of contractors are not only of common occurrence, but that they are allowed to pass unnoticed. If, however, further proofs of this last assertion be considered wanting, the flies of the Department will furnish it, as in the case of St. John's light-house, East Florida, where the fraud was discovered of building the walls hollow, and afterwards settled by arbitration, the judge, or arbitrator, proving to be a silent partner of the contractor. Also, in the case of St. Mark's light-house, East Florida, where similar fraud was discovered; also, at the Southwest Pass of the Mississippi river, where a gross case of fraud was committed and brought to the notice of the Department, but the evidence was quashed, the contractor allowed to go on with his nefarious work, and rewarded with damages to the amount of $9,505 09, which stimulated his rapacity to make another claim on Congress for $6,296 28, but that was most justly rejected. (See Doc. 983, 27th Congress, 2d session.)

VISIBILITY OF OUR COAST LIGHTS.

The distance at which the coast lights of Massachusetts can be seen varies directly as the order and character of the apparatus with which they are respectively provided, limited of course by their heights above sea level. Many of them are invisible some miles within the distance at which they should be seen, if illuminated with suitable apparatus. Among the most important of these nearly invisible lights are Monomoy and Nantucket. These two lights are between eleven and twelve miles apart; and half way between, or at six miles distant from either, no
light is visible. This result was observed in clear and pleasant weather, on several occasions, while cruising in the neighborhood. Their reach, according to elevation, should be, for Nantucket, 12.20 miles, and for Monomoy, 9.81 miles.

The Fifth Auditor's catalogue gives the reach of the former as 18 miles, its height being but 70 feet above high-water mark; while Gay Head, a revolving light, (always seen more distinctly than fixed lights,) 172 feet high, is rated at only 21 miles—three miles greater reach only being allowed for a difference in height of more than 100 feet; and Race Point light, which is but 25 feet above sea level, is rated at 25 miles, or four miles further than Gay Head, although lower than the latter by 147 feet, and so on throughout the catalogue.

The same author states that Cape Henlopen and various other lights can be seen 35 miles, which, according to the geodetical table constructed by the late Dr. Bowditch, involves a height, of tower and observer combined, equal to 700 feet, due allowance being made for refraction. To prevent any misapprehension on this point, the following rule for determining the distance at which the rotundity of the earth's surface allows elevated objects to be seen is here submitted, and also that portion of the table of Dr. Bowditch requisite to the illustration of this mooted point. Mr. Vince, an English astronomer of considerable celebrity, is the author of this rule, and it is thus enunciated in logarithms:

Rule.—0.12155 + half log. of height in feet = log. dist. in statute miles.

In reducing the rule to logarithms, the radius of the earth was called 20,911,790 feet, which agrees nearly with the mean value given in De Lalande's Astronomy. (See Bowditch's Navigator, preface, p. 5.)

The reach of the several lights on the coasts of Maine, New Hampshire, and Massachusetts, is taken from this table, allowing the height of the observer's eye to be 15 feet for those denominated of the first class, 12 feet for the second, 10 feet for the third, and 8 feet for the fourth class, being about the height of vessels' decks of the usual tonnage employed in the merchant service. The portée, or reach, is thus put down at the fair minimum for clear weather, anything like extraordinary refraction being neglected, because it is as likely to be lateral as vertical. If the lights are occasionally visible at much greater distances, it varies from atmospheric influences, which also too often render the whole invisible, as in the case of dense fog or snow storm.

This basis is adopted in stating the reach of the English and French lights, and for similar reasons, though apparently inexplicable to the Fifth Auditor, who still reiterates the assertion that our lights can be seen further than those of either nation. It is hardly necessary to observe here, that assertions like these go for nothing against the authority of such men as the translator of Le Mécanique Celeste.

**Construction of Light-houses on the Coasts of Maine, New Hampshire, and Massachusetts.**

The light-houses of Maine consist of two distinct forms, viz: conical towers of rubble-stone masonry, and wooden-frame towers, erected upon the roofs of the keepers' dwelling-houses. The variation of detail among
the whole number examined being very trifling, a description of one of each kind will apply to all.

The conical stone towers of rubble masonry are, in all cases, founded upon rock, the surface of which is left with its natural irregularities, and no attempt made to excavate or even to reduce it to a level plane. In some examples, the building stone has been split from the adjacent ledge; in many others, collected from the beach, or fragments of the cliffs, rounded by attrition amidst the surf. The thickness of the walls is commonly three feet at the base and two feet at the summit of the tower, and their heights vary from twenty to fifty feet. The mortar used in these constructions is common lime and sand, the proportion of the latter over the former being such as to forbid 'all cohesion or "set."' At the top of the tower, and within the walling of rubble, a dome of brick is turned, with a square opening near the springing line on one side, forming the scuttle entrance to the lantern. On this brick dome a flat roof, composed of some fifty slabs of soapstone, four inches thick, is laid; the joints of course being vertical, and the exterior circle of slabs projecting over the walls of the tower from six to twelve inches. There are no cramps, dowels, or fastenings of any kind, to secure these slabs in their places—nothing but their own weight. The spandril of the brick dome is left hollow. The following effects result from this peculiar and very defective construction: During a gale of wind, the current of air intercepted by the conical surface of the tower, is driven upwards, the projecting eaves of soapstone are lifted by this force sufficiently to admit the rain and spray of the surf, which thus finds its way into the spandril of the brick dome, where large quantities of water remain after every rain storm. The vertical joints of the slab roof also admit their share.

This reservoir of rain and salt water, at the top of the tower, causes the rapid decay of the whole structure, by filtering downwards through the joints of the masonry, dissolving the weak mortar, separating the lime from it, and leaving merely the sand, rotting all the wooden lintels and the ends of the wooden steps of the staircase, which are always very improperly bedded in the masonry of the interior walls. In winter the effects become visible in a still more destructive way. Frost and ice being formed, the masonry is disjointed, face stones thrown from their beds, huge icicles gather on the interior walls, and the staircase becomes a perfect glacier. Of thirty-one light-houses upon the coast of Maine, twenty-four were found more or less injured from this cause alone, and thirteen of the number require rebuilding entirely.

The manner of attaching the lanterns to the roofs of the towers is by imbedding from three to four feet of the lower ends of the iron angle posts in the masonry of the walls, and the rapid corrosion produced by their being always surrounded with moisture is such as to necessitate entire renewal after eight or ten years. The window and door frames are not rebated into the masonry, but merely set in openings left for the purpose, and flush with the exterior surface, their sides being pointed round with lime mortar. This pointing soon scales off, and the rain finds easy entrance to the interior of the building. The entire construction of these towers is of the rudest description.

The second form of towers (the light-house at Mount Desert rock, one
of the most exposed situations on the coast of Maine) is of timber, framed into the roof of the keeper's dwelling-house. The angle posts rest upon the attic-floor beams, and are not supported by studding of any kind from below; consequently the whole weight and stress of the tower and lantern are borne by the horizontal beams, whose ends are bedded in the walls. The diagonal cross braces serve to stiffen the tower frame whilst they add to its weight, and the only preventive to lateral motion is the common rafters. In every example of this method of construction examined the same results were apparent, viz: a distortion of the framing of the roof of the house by lateral swaying motion of the tower in storms, and consequent opening of all the joints, causing profuse leakage. The same movement of the tower destroys the plastering of the ceilings beneath, and the frame-work of the house rapidly decays, from the continual lodgment of moisture. The ignorance of all well-established principles of construction displayed in these works is very remarkable, considering the section of country in which they are located, where mechanical ingenuity and a thorough knowledge of building are so common. It is but justice, however, to state that this very peculiar design had its origin in another latitude, and has been liberally scattered along the coasts, from Maine to Maryland.

The dwellings of the keepers are very similar in all their principal features, viz: rubble-stone walls, shingled roofs, and brick chimneys. The most usual plan is, a division of the principal floor into three rooms, having a cellar beneath, and three chambers above in the attic, which are always small and inconvenient, besides being cold and uncomfortable. The details of the work and materials are of the very roughest description, requiring regular annual repairs to greater or less amounts, according to the severity of the winters. At every station the complaint of smoky chimneys was made, which the appearance of the blackened ceilings fully corroborated in most cases. Very few of the stations were provided with the proper means of obtaining pure water for domestic use. Wooden tanks, of a cylindrical form, hooped with iron, are placed in the cellar, and receive the product of rains from the roof of the house. This is the most common arrangement, but the tanks soon become rotten and leaky, while the water obtained from the roof is generally brackish, owing to the incrustation of salt upon the shingles after a storm. Wells of spring water were seldom found at any place visited. On all the out stations, such as Mount Desert Rock, Matinicus, and Saddleback, the keepers suffer severely for the want of good water, and are obliged to collect it from the hollows in the rocks, or bring it from the main land in casks, some eight to twelve miles distant.

Another fertile source of expenditure and trouble is found in the boats, boat-houses, and boat-slips or railways, upon which they are launched or drawn out of the water. No light-house keeper should be without a good boat, and this of course will be entirely useless to him unless the means of handling it easily are at command. There have been many instances where keepers have saved the lives of shipwrecked seamen by means of their boats, or have been enabled to render valuable service to vessels in distress. The boats allowed to keepers are generally small clinker-built canoes, or common flat-bottomed dories. The boat-houses
are mere sheds, and the boat-ways or slip-sticks of timber laid parallel to each other, extending from the boat-house to low-water mark, and secured to the rocks by iron stays. It is commonly the case that this construction is demolished once or twice every year by the surf, and whenever this occurs the keeper's boat becomes useless. The remedies for such difficulties are as numerous as simple.

Before leaving the subject of construction, it seems proper to introduce here some notice of the Saddleback light-house, which is the only establishment on the coast of Maine that possesses any claim whatever to superiority, in respect to material or detail over its fellows. It will be seen that this is simply a conical tower of hammered granite, the base being sunk below the surface of the rock, and resting upon a level plane, quarried out for the purpose. The stones of each course are equal to the thickness of the wall, and the joints, being very close, are filled with hydraulic cement of pure quality. The sea breaks quite over the lantern in a southeast gale. The tower contains four apartments for the use of the keeper, but no convenience for collecting fresh water, nor any means of securing the boat—both important omissions. However, the cost of the work was but $15,000, and it is the most economical and durable structure that came under observation during the survey, and, what is worthy of special remark, the only one ever erected in New England by an "architect and engineer."

The advantage of employing professional men of reputation in these public works, instead of selling the contracts to the lowest bidder, cannot better be illustrated than by contrasting the construction of the light-house on Whale's Back rock with the Saddleback tower, just described. The peculiarities of location are nearly similar, both being exposed to the heaviest shocks of the sea during storms. This tower rests on a circular pier of rough split granite blocks, forty-eight feet diameter at the base, and twenty-two feet high. This pier is laid up dry, without bed or build to the courses, without any attempt to level the uneven surface of the ledge on which it rests, and at a cost of $13,810 33—nearly as much as the entire cost of Saddleback light, which is smooth hammered granite throughout. On the pier thus rudely and fraudulently constructed, was erected a stone tower thirty-two feet high, at an additional cost of $6,150, and this was cased on the sea side with wood, but only "for the comfort and health of the keeper, at the inconsiderable expense of $307 38." (See Doc. 811, p. 77.) Here is a contract specimen, costing upwards of $20,000, constructed of solid masonry, or intended to be, and yet so fraudulently done (although supervised by some very honorable person, whose name is suppressed from motives of delicacy,) that the miserable expedient of a wooden jacket over a stone tower is required, to make the keeper healthy and comfortable. Every subsequent year, up to the time of this inspection, repairs have been continually required, and workmen were employed at the time of my visit in securing the foundations with heavy iron bands and straps. No human art can, however, make a firm structure of it. When there is a heavy swell rolling in, the base of the tower is struck with such force as to shake the whole edifice in the most alarming man-
ner. The keeper asserted that the vibration was so great as to move the chairs and tables about the floor.

There are but two light-houses on the sea-coast of New Hampshire, one of which is within the harbor of Portsmouth, and is an octagonal wooden frame tower, 80 feet high, and forty years erected. It is an excellent piece of carpentry, and will bear favorable comparison with its more modern neighbors.

The other is a conical rubble-stone tower, similar to those before described, and is erected on the Isle of Shoals.

The stone tower has been cased with wood outside, to protect the masonry—a most singular expedient, but very fair exponent of the character of the original work erected in 1820.

The light-houses of Massachusetts are constructed of rubble stone, brick, or wood, the details being in all respects the same as those upon the coast of Maine. The same neglect of securing the foundations is common to all. This defect is most remarkable among the brick towers, as well as keepers' houses, erected upon the sands of Cape Cod and other locations. The contractors have simply smoothed off the surface of the sand to a level and laid their brick-work thereon, without footings, platforms, or any preparation whatever. At Ipswich there are two brick towers, their bases being eight courses below the surface. On scraping away the sand, the base course of brick could be removed by hand, and the mortar had apparently never set. At Billingsgate island, the keeper stated, that, a few months after his dwelling-house was erected, (of brick laid on the sand, tower of wood on the roof,) the front wall fell entirely down, leaving the interior exposed to view. All the brick light-houses and keepers' dwellings that were visited were of a similar character. The contractors, to save material, filled the interior of the walls with rubbish of various kinds.

The stone and brick towers are all roofed with soapstone slabs, (as in Maine,) and all leak more or less, in consequence. The two brick light-houses and keeper's house at Chatham, though scarcely twelve months erected, are complained of by the keeper as leaky and defective in a remarkable degree. (See his statement.) The establishments at Plum island, Squam, Straitsmouth island, Scituate, Plymouth, Billingsgate island, Monomoy, Point Gammon, Cape Poge, Tarpaulin Cove, and Gay Head, were found in a state of partial or complete ruin, and all require rebuilding. Cuttyhunk light-house, a rubble stone tower, has been twice cased outside with brick, from base to top, and yet it is leaky, from the original error of using soapstone slabs for a roof, while the wood-work of the keeper's house is rotten in every part.

An illustration of the usual method of constructing brick light-houses is presented, showing an elevation and vertical section of the light-house at Truro, Cape Cod, which was erected by contract in 1833, at a cost of $4,162. This tower was refitted by me in 1840. It will be seen that, in the original construction, the door and window frames, of wood, were set flush with the exterior surface, and at the same angle of inclination. These, with the wooden staircase, (the ends of the steps and risers being bedded into the masonry,) were all rotten. The window frames and staircase were pulled out by hand; and the removal of the latter brought
down a portion of the inner face wall, when it was discovered that the interior of the walls was laid without mortar, the brick being loosely thrown in, and the interstices filled with sand. At the base, which 
exted on the surface of the ground, there was found in the interior of the wall a large number of stones, thrown in to fill up and save brick. On removing the lantern, the mortar of this superstructure was found to have so little cohesion, that the masons, to save time, shovelled off the bricks; and thirteen feet of the tower were taken down in this manner, before arriving at a part that presented sufficient surface and stability to justify a reconstruction. The tower was, however, rebuilt, and rendered fire proof throughout by the introduction of cast-iron door, window frames, sashes, staircase, roof, and lantern, together with a hot-air furnace, to heat the building in winter. The door and window frames were recessed, and set perpendicularly. The newel of the spiral stairs, being a cylinder of cast iron, communicating by means of a flue, (passing out below the base of the tower,) with the external air, and receiving near its top the smoke pipe of the furnace, assists materially in ventilating the lantern during cold weather. The roof of the tower is formed of one disc of cast iron, fifteen feet in diameter, with a flange beneathe, six inches deep, that shuts down over the cornice, and effectually prevents all leakage. The plinth and dome of the lantern are also each cast in one piece, the latter being supported by sixteen wrought-iron stiles, four by one inch, set edgewise to the light. There are but sixteen panes of glass in the lantern, each five feet high and two feet wide. The lamps are cast-brass Argand fountains, with ½-inch burners; the reflectors, true paraboloids, (made on a cast-iron die, turned and polished with the utmost care,) twenty-one inches in diameter, with a focal axis of three inches, plated with twenty-one ounces of pure silver, and weighing fourteen pounds each. The burners are perfectly adjusted to the focal point, and so attached to the frame-work that the keeper has no power to alter the adjustment. The reflectors are also set truly vertical, and without the possibility of being disturbed in their positions either by carelessness or accident. The whole lighting apparatus is supported upon a massive frame of cast iron, placed in the centre of the lantern. Much animadversion has been thrown upon this construction, from the fact that its cost $5,919, which amount is contrasted with the expense of refitting by contract the light-house at Cape Henlopen for $3,600. In Document 811, (2d session 27th Congress, page 72,) the items of respective cost are set forth by the Fifth Auditor, in a letter to George Bancroft, Esq., endeavoring to convey the idea that the refit was of a similar character in both cases, and that, therefore, the cost should be the same. The statement there made is not a fair exposition of the truth. The lantern at Cape Henlopen was one of the old form—made of wrought iron—octagonal in the plan, and glazed with small plates of window glass, sixteen by twenty-four inches square. The roof of the tower was soapstone slabs—a wretched expedient, too, for the purpose, as already proved. Five hundred dollars is charged as the cost of this roof, which is three times the actual cost. The reflectors were made on the wash-bowl system; and the silver plate peeled off in spots from nine of them, in one year, after being put up,
as stated by the superintendent of the district in his annual report to
the Fifth Auditor for the year 1841.

The whole character of this work is like others hereinbefore noticed as
done by contract. But the most important item is omitted, viz: somewh
ere about the sum of $5,000, paid the same contractor, and at the same
date, for putting a plank fence round the tower, to retain the drift sand,
and which has been found utterly useless; and it has been necessary
from time to time to cart in earth, &c., to prevent the tower from being
undermined. The cost, therefore, of refitting Cape Henlopen light-
house was about $8,600. The light-house at Cape Cod was, in effect,
rebuilt throughout; while that of Cape Henlopen was merely supplied
with a new lantern and a plank fence, as aforesaid. If the Fifth Audi-
tor had also published the reply of Mr. Bancroft to his strictures upon
the work done at Cape Cod, the case would then have been fairly and
honorably stated; and the public could have rightly judged whether a
reconstruction of nearly an entire light-house, with a material used for
the first time in our light-house establishment, (cast iron,) requiring
numerous and expensive patterns, was a fit subject of comparison with
the work of a contractor hackneyed in all the tricks of his trade. The
work at Cape Cod has withstood the storms of three winters, without a
blemish. Can the same be said of Cape Henlopen light-house? Not
with truth.

The numerous frauds practised in the construction of our light-houses,
is fully proved by the continual call of the keepers for repairs. The
detailed statements on this subject will illustrate the fact. A striking
example, however, is to be found in the following affidavit of a respect-
able mechanic, who supervised the erection of the curious trio of light-
houses on Nauset beach. The three towers, dwelling-house, and appa-
ratous, were all erected in thirty-eight consecutive days, by a gang of
ten men, two of whom were sick the last half of the time.

Affidavit of David Bryant, carpenter, and superintendent of construction
at the Nauset light-houses, erected in 1838.

I, David Bryant, carpenter and builder, of lawful age, and a resident
of Boston, in the county of Suffolk and State of Massachusetts, on oath,
declare and say, that, in the year eighteen hundred and thirty-eight, I
was employed by George Bancroft, Esq., then superintendent of light-
houses in Massachusetts, to supervise the erection of three light-houses
and a dwelling-house at Nauset beach, in the town of Eastham, on Cape
Cod, according to a contract entered into on the twenty-sixth day of
May, in the year aforesaid, between said Bancroft, on behalf of the
United States, and Winslow Lewis, Esq., of said Boston, and received
for my services two dollars and one-half a day.

The sites of the towers, as selected by Captain Percival, of the United
States Navy, were on a line parallel with the line of the coast; and
stakes were driven into the ground at their respective positions, and the
bricks for building the towers were landed around these stakes, before
the contractor arrived on the ground. I was informed by the chairman
of the county commissioners, and by other persons, that the stakes above
referred to were the points selected by Captain Percival for said light-houses. The towers are not built upon these points. The southern towers are carried back from the shore, the most southerly one a distance of some eighty or ninety feet from the stake, placed by Captain Percival to mark its position.

I remonstrated, at the time we commenced our work, against this change of position, to the contractor, and stated to him the impropriety of making such a change, and the effect it would have upon the safety of vessels upon the coast. The reasons that induced the contractor to carry these towers back from the shore was to get the base or foundation of the southern tower on lower ground, and nearer the level of the base or foundation of the northern tower, and to save the materials that would be required to build the northern tower to a level with the southern, as it would have been had it been placed where Captain Percival intended it to be, and fifteen feet above the level of the ground more than were required to carry the northern towers to the level of the southern tower, as now constructed, which would be at least or near five feet. The contract specified that the foundations of the three towers should be sunk as deep as may be necessary to make the fabric secure; they were to be built of brick, and, no foundation of any other material being specified, the bricks were laid directly upon the sand, which was removed or scraped off to a level about eighteen inches below the surface. There was no other material laid upon the sand, to preserve the level of the brick-work, nor any footing to the walls, to render them more secure.

In laying up the brick-work, the masons laid the fair course outside and inside, and then shovelled on mortar between these two courses and laid the bricks comprising the interior of the wall entirely at random, or without any regard to forming a bond in the masonry. There were no headers laid until the walls had been built up near to four feet in height, and the next course of headers were laid when the walls were about eight feet high. Good work requires headers to be laid every sixth or seventh course of the bricks. I detected the masons several times shovelling in sand instead of mortar; and, as there were three towers and the keeper's dwelling-house all building at the same time, and the towers were one hundred and fifty feet apart, the workmen could easily use improper materials while I was absent from one or other of them. When the work was completed, I prepared a list of the several parts of the work that had not been completed according to the contract, and of the parts of the contract that were therefore not fulfilled, and left the same with the said George Bancroft.

The specifications of the contract were so loosely worded that it left many of the most important points to the honesty of the contractor, or to such construction of its meaning as the contractor saw fit to prefer. From this cause, there were many parts of the work which ought in justice to have been condemned, that I was obliged to accept, owing to the phrasology of the contract. I considered the whole of the work as of the meanest character and description. The three towers, with the lanterns and apparatus complete, and also the keeper's dwelling-house and out-house, and a well dug forty-five feet deep, were all completed, constructed, and whitewashed and painted, and finished off, and
ready for occupancy and use, in the short space of thirty-eight consecutive days. The force employed consisted of four masons, two carpenters, three laborers, and a cook; one of the masons and one of the carpenters were sick with the small-pox during the latter half of the time above mentioned. When the job was finished, I was called upon by the contractor to sign a certificate that the terms of his contract or agreement had been honorably fulfilled. This paper I refused to sign, and referred the contractor to the collector at Boston, to whom I made a formal statement of the facts upon my return to Boston from Cape Cod. After a delay of some time, I received notice to call on the collector at the custom-house; and, when I called there, I was directed to sign the certificate of approval before named. Upon inquiring why I should sign it when its contents were untrue, I was told that the Fifth Auditor had accepted the work, upon the representations made to him by the contractor, and had ordered the contractor to be paid, and that I must sign the document as a matter of form, and I thereupon did sign the same. I considered my objections waived by the Government.

Signed this second day of December, A. D. eighteen hundred and forty-two.

DAVID BRYANT.

COMMONWEALTH OF MASSACHUSETTS, Suffolk, ss.:

Then appeared the above-named David Bryant, and made solemn oath that the foregoing affidavit, by him signed, is accurate and true, and that the statements and matters therein contained and set forth are all accurate and true.

Before me:

THOMAS B. POPE,
A Justice of the Peace in the County aforesaid.

BOSTON, December 2, 1842.

ILLUMINATION
Of light-houses upon the coasts of Maine, New Hampshire, and Massachusetts.

There being one common plan of lighting adopted in all the United States light-houses, it is only necessary to describe this plan and its various modifications, and to show the great error of its projectors in the application of one universal principle to every imaginable locality. It will be necessary, however, to premise this statement with some account of the true origin of the method of illumination adopted by our Government in 1812, and also a brief retrospect of the earlier methods practised in Europe. The European light-houses were illuminated until 1784 with huge fires of coal or wood, exposed in open braziers placed on their summits, or with tallow candles enclosed in lanterns.

In 1784, Argand, of Geneva, patented his celebrated lamp. In the same year, the Chevalier De Borda applied it to the illumination of the Great Tour de Cordonna, by placing a number of Argand burners in the
foci of parabolic silvered mirrors. (See Encyclopædia Brittanica, 7th edition.) Senior, the first optician of the day, was employed by De Borda to construct the parabolic mirrors of silver, plated on copper. This important step towards the improvement of light-house illumination was immediately afterwards followed by the British government—several of the elder brethren of the Trinity House having visited the Tour de Cordonna expressly to examine the invention of De Borda, which was first exhibited at the Portland light-houses, as will be seen by the annexed letter from J. Herbert, Esq., secretary to the Corporation of Trinity House, London:

TRINITY HOUSE, LONDON, December 16, 1842.

SIR: Adverting to the inquiries contained in your letter of the 24th October last, I have now the honor to acquaint you that parabolic silver-plated reflectors and Argand burners were first adopted for use by this corporation in the year 1788, and were first exhibited at the Portland light-houses in that year.

With regard to the latter inquiry in your letter, as to the period when the same instruments were first used in France, I beg to state that I am unable to furnish you with that information; but should you feel disposed to apply to the Light-house Board at Paris for the same, M. Laurence Fresnel, their chief engineer and secretary, is the person to whom your inquiry should be addressed.

I am, sir, your most humble servant,

J. HERBERT.

I. W. P. LEWIS, Esq.,
[See, also, Captain Cotter's History of the Trinity House.]

In 1786, one of the first acts of the Scottish board of light-house commissioners was to authorize the substitution of reflectors and oil lamps for coal lights in all their light-houses. These reflectors were paraboloids, formed of facets of mirror glass, set in a hollow mould of plaster, and were the invention of Thomas Smith, Esq., engineer to the board. In 1804, the silver-plate reflectors were introduced in the Scottish lights by Robert Stevenson, Esq., then and now engineer to the board of commissioners. The annexed letter from Mr. S. will, it is hoped, satisfy those who are so skeptical as to insist that the light-house apparatus of this country was an original invention, and entitled to the benefit of patent. A concise and interesting history of the subject will be found in the seventh edition of the Encyclopædia Brittanica, resting upon undisputed authority.

EDINBURGH, November 18, 1842.

SIR: I have received your letter of the 24th ultimo, and I beg briefly to state as follows:

1. That on the coast of Scotland silvered or plated copper reflectors were first permanently employed at the light-house of Inchkeith, in the year 1804.

Note.—Reflectors, of the parabolic curve, formed with facets of mir-
ror glass with common wick lamps, were used in Kinnaird Head lighthouse, on the coast, as early as the year 1787.

2. The silvered copper reflectors have never been used on this coast without Argand burners; which burners have also been occasionally used in parabolic reflectors formed with facets of mirror glass.

3. The history of the French improvements in lights is somewhat scanty; but under the head "Catoptric System," in the accompanying pamphlet, or article "Sea Lights," which my son Alan drew for the 7th edition of the Encyclopædia Britannica, you will find the best improvement we have been able to obtain, and which has been seen by the present secretary of the Light-house Commission of France, who has not stated anything in opposition to it.

4. The reflectors were not first introduced by me into Scotland or England, but were very greatly improved both in their form and the mode of adjusting and preserving the lamp in the focus of the reflector. On this subject I beg leave to refer to my "Account of the Bell Rock lighthouse," pages 28 and 527, and the drawings referred to. There is a copy of this book in the possession of your Government.

5. The silver-plated reflectors have been in use, without being perceptibly injured by cleaning, for thirty-eight years in some of the lighthouse stations. The burner lasts quite as long, except the inner tube, called the spiral, on which the wick is raised, and which is of course enveloped by the flame.

6. The mirror glass reflectors are formed to the parabolic curve, as nearly as may be, by the facets of glass being bedded with a gum upon a surface of plaster of Paris, or stucco, cast upon a mould.

The silvered copper reflectors are formed on a mould, by a process of successive hammering, and are gouged out and inside during the process. Of this, see the account before referred to, at page 527, and also the article "Sea Lights," sub. voc., "Manufacturing and testing reflectors."

I hope the above information may prove satisfactory to you, and I shall be happy to furnish any other facts which I may have.

I remain, sir, your very obedient servant,

ROBERT STEVENSON.

I. W. P. LEWIS, Esq.,

In 1812 our Government purchased, at the price of $20,000, a patent right for illuminating their light-houses, which patent was styled "Magnifying and reflecting lanterns." This apparatus consisted of the Argand lamp and a spherical reflector, with a kind of lens placed in front, (known in common parlance as a bull's eye, and used, on account of its great thickness, to transmit light through cellar doors, hollow pavements, and ship's decks.) This apparatus was enclosed in massive wrought-iron lanterns, glazed with small panes. 10 by 12 inches square, and was a rough copy of the English method then in use. It is believed to have been copied from the apparatus at the South Stack light-house, of Holyhead, in the Irish channel, the patentee having visited that establishment in 1809, soon after its being put in operation. Although a patent
was granted for this apparatus, (the original type of which is herein traced back to the year 1784, and was the combined invention of Argand and De Borda,) yet it would seem, from the style of the patent, that the claim was made for some peculiar magnifying and reflecting property of the lanterns. However this may be, the simple fact of concealing the lamps from view behind a lens of green bottle glass, four inches thick through the axis, implies entire ignorance of the properties of artificial light, as well as of its refraction. It is but a few years since these bull’s eyes (for to call them lenses is a misnomer) were removed from our light-houses. In 1838, they were used at four places in Long Island sound. In 1840, one set was taken down at Faulkner’s Island light.

Up to the present time, no change in this patent plan of illumination has been made, (save turning out the bull’s eyes,) except in a few isolated cases, one of which, and the most important, is the lenticular double light at Navesink, New Jersey. This valuable improvement, the next in order after De Borda’s, was invented in 1822, in France, by M. Augustin Fresnel, member of the Institute, and one whose rare discoveries in optical science are still the admiration of European savans. M. Fresnel adopted, as the basis of his experiments, the refraction of artificial light, by lenses and prisms of glass, instead of its reflection by polished metallic surfaces, and the perfect success that rewarded his labors is attested by the fact of his lenticular system being adopted by the French government, and placed in all their most important coast lights, where the greatest brilliancy and effect are required. In 1837–38, a most urgent memorial from Messrs. Blunt, of New York, was presented to the United States Senate, setting forth the inferiority of our light-house illumination, the fatal consequences arising from the want of capacity and intelligence of the acting superintendent, the evils of the contract system, and a description of the superior arrangement of the French lights. In consequence of this memorial, a bill was introduced by the honorable John Davis, of Massachusetts, to authorize the importation of a set of lenticular apparatus and English reflectors; both of which were purchased, imported, and set up—the former at Navesink, the latter at Boston. These two establishments were, therefore, the first of their kind ever fitted up in the United States upon the principles for which they were respectively designed. Had not the action of Congress been taken, based upon the just complaints from our first commercial city, we should have remained to this day without even the two examples above named to boast of.

In the winter of 1839–40, an enterprising firm in Boston undertook the manufacture of silver-plated reflectors for light-house purposes upon an improved plan. The moulds and dies for these mirrors were prepared with scientific nicety, and in obedience to the optical laws governing the subject. The first specimen produced was sent here to the office of the Fifth Auditor, where it still remains. The following year a fictitious imitation of these reflectors was got up by other parties, and adopted by the Fifth Auditor, in preference to those made upon approved optical principles.

The illuminating apparatus, patented in 1812, and now used in all
our light-houses, will be best understood by inspection. The lamps are
roughly constructed upon the principle of Argand's fountain lamp, and
have all burners of three-fourths of an inch diameter, consuming from
thirty to forty gallons of oil each per year, the variation in quantity
depending mainly upon the size and ventilation of the lanterns. The
lamps are attached to the inner circumference of an iron circular frame
by two hooks inserted in small holes, and their stability is preserved by
means of two screws, acting against the back of the fountain, which also
more particularly serve the purpose of raising or depressing the level of
the oil in the burner, by tipping the fountain backward or forward.
Thus, in cold weather, when the oil is dense and chilled, it becomes ne-
cessary for the keeper to advance the upper screw and retreat the lower
one, by which process the fountain is tipped forward, and the oil rises
higher in the burner, or nearer to the top of the wick. In summer the
oil becomes expanded by heat, and the reverse operation is performed.
The effect of this is, to alter the position of the burner with regard to
the apex of the reflector, and of course its adjustment with respect to
the focus is vitiated at once. The reflectors are of thin sheet copper,
plated over with a thin film of silver, and, commonly, segments of a sphere,
or nearly so, though the material of which they are composed is so thin
that they become very much altered in form by compression between the
iron arms that support them. At the back of the reflector, a hook of
sheet copper is soldered on, which, with two small straps of the same
metal, soldered at the outer edge, and that fit on to hooks at the ex-
tremity of the iron arms aforementioned, serve to retain it in position.
The silvered concave surface of these reflectors has much the same grain and
lustre of tin ware, and upon holding your finger near one, no distinct
image is visible. In some cases the reflectors approach the paraboloidal
form, but in no instance, even among those recently fitted up at a great
cost, was there found a series perfectly similar in figure; and this is a
necessary consequence arising from the method pursued in their manu-
facture, which is as follows: The plater performs his task by rolling out
a disc of copper, coated with a thin lamina of silver. This disc of metal
(varying in diameter, according to the intended size of the reflector) is
then passed over to a coppersmith, who, by a process of hammering, at-
length obtains a sufficient concave; the curvature he ascertains by means
of a wooden mould. Next, the silversmith takes the work in hand, and
burnished the concave silvered surface, which completes the manufacture
of a reflector, as practised in this country, and differs in no respect (ex-
cept the burnishing) from the common method of making tea kettles and
barbers' basins. It has been publicly asserted, (by the favored indi-
vidual who rejoices in the title of patentee of this branch of industry,) that
light-house reflectors are not optical instruments, nor in any way
connected with that science; and certainly this assertion is most fully
corroborated, so far as the American light-house establishment is con-
cerned; for, among the more than seven hundred specimens measured
during this inspection, it would be slanderous to say that any one of the
number claimed relation with science, and but little with art. Yet again
it is claimed, by this same patentee, that these reflectors (after directly
stating his contempt for and ignorance of optics, as connected with his
plated wares) are perfect in form and operation; and that they have a "focus" of three inches, and no other. But his works again contradict this last assertion, for, among three examples executed under his immediate personal supervision, at an expense to the Government of $10,870, there is not a single burner placed in the position he pretends to be the proper one, nor among the three distinct series of reflectors any two precisely of the same curvature. At White island, one of the examples alluded to, there are no less than four sizes and curvatures among fifteen reflectors, with focal axes varying from two and a quarter to four inches, by approximation, for not one of the whole series is a perfect paraboloid.

As parabolic reflectors are known to give the most intense effect when the burners are perfectly adjusted to the focal point, so it was taken for granted, on this examination, that the persons employed to fit up the light-houses with the illuminating apparatus would attend most carefully to the practice of this rule. The necessity also of having each reflector secured with its axis truly horizontal it was also supposed would be particularly noticed. But, in every instance, these important elements were omitted; and, in fact, the arrangement, design, and construction, of the entire apparatus, is such as to render these adjustments impossible; consequently, the burners were never found in any one series uniform in position, the variation amounting to more than one inch, and the reflectors out of the perpendicular from a half inch to two inches. It is evident that, if the reflector does not stand truly vertical, its axis will be either depressed or elevated, and the light from it fall upon the earth or ascend to the stars, without being visible to the navigator.

The arrangement of the lamps on circular horizontal planes in all the fixed lights, without regard to peculiarity of location or the evident wants of navigation, is one among the most provident errors of the present system, common to all the fixed lights in the United States, and the large number of lamps required by this plan to illuminate a given portion of the sea horizon will appear evident, when it is seen that each reflector can only cover a certain space in the direction of its axis, and in no other. Thus, in narrow channels or straits, rivers, and estuaries, where light is only required in one or at most two directions, we have it in eight or ten directions, three-fourths or four-fifths of the oil burning to no purpose whatever. This remark will be best understood by reference to the diagrams annexed to the detailed descriptions of each establishment, which are sketches of the site and neighborhood of various light-houses, as stated on the face of them. The radiating red lines show the exact direction of the axis of each reflector, and also their number. It will be seen that among several the rays pass over the land, where of course they are useless, and the oil burnt to waste; others, where the number of lamps is too great; and, again, where they are deficient. There are many cases which will be found mentioned in the detailed descriptions of each light-house, and also in the catalogue, where lamps have stood facing the copper door of the lanterns for a long series of years, their light being entirely lost. In the case of revolving lights, it will be seen that the reflectors are arranged upon the arc of a circle, producing a divergence of their respective axes of thirty to forty degrees on each side of the centre, and a consequent diminution of effect. If the
reflectors were placed with their axes all exactly parallel to each other, their combined effect would be very much greater than it is by the first-named method; the only advantage claimed for which is, that the bright periods are prolonged to the eye of the observer.

The lanterns containing the lamps and lantern reflectors, are by far the most curious part of the light-house establishment. They are all of one uniform model, differing only in magnitude—octagonal on the plan, the height of the sides being about equal to the diameter at the angles. The frames are very ponderous, of wrought iron, and containing, by a fair estimate, three times the quantity of material requisite. The angle posts are two inches square, and, with the sashes attached, the width of the angles is increased to four inches; the sash bars are one inch wide; and the glass mostly 10 by 12 inches square, (excepting a few fitted up quite recently, which were copied from the improvements made at Boston light,) and of the most impure kind, full of striæ and veins, so that what light escapes from its iron cage is refracted in all directions by the effect of the glass, and but a small portion reaches the eye of the observer. The annexed diagram* (No. 1,) exhibits the eight faces of one of these lanterns, extended on a plane, with the several amounts of opaque surface that cut off the reflected and direct rays of the lamps, all collected into one mass, (figure 1.) Beneath it is shown another diagram (No. 2*) of a lantern invented and erected in 1840, by your reporter, at the Highlands of Truro, Cape Cod, having its sixteen faces developed in a plane, and the opaque surfaces of the frame-work that intercept the light being likewise condensed into one mass. (figure 2.) The difference, as will appear upon inspection, is very great indeed, amounting to nearly fifty square feet of surfaces. The first lantern of this kind in the United States, was designed and erected by your reporter, in 1839, at Boston light-house, to receive the English reflecting apparatus before alluded to; and, in addition to the removal of about eight-ninths of the obstructing surfaces, the important point of ventilation was carefully studied and successfully attained. In the old lanterns, one uniform rule of ventilation is followed. Four circular openings, each three inches in diameter, are cut in opposite faces of the octagon, near the floor, to admit air. These the keepers generally shut up, and cement the joint tight with putty, to prevent the rain driving in; consequently, the lamps are supplied with air through the scuttle in the floor. The escape pipe on the top of the dome of the lantern is only three inches in diameter, through which all the rarefied air, smoke, and gases of combustion must pass. The necessary current of pure atmospheric air is thus rendered sluggish; large quantities of vapor are produced by the combustion of ten to twenty lamps, which is condensed on the glazing of the lantern, (this the keepers term sweating—see their statements,) and is a source of great annoyance to them, and damage to the apparatus. In winter, the vapor is congealed into frost and ice, at times, to the thickness of half an inch. In summer, the floor is puddled with water.

By the process of ventilation applied to the lanterns at Boston, Truro,
and three other places beyond the scope of this inspection, the accumulation of water on the glazing is completely obviated. There are eight valves in the plinth of the lantern, to admit pure air at the will of the keeper. On the top of the dome is a ventilator, whose peculiar form induces a vacuum within itself, whenever there is a breeze moving. By these means, a steady current of pure air is continually passing through the lantern, whose strength is sufficient to remove all the gases of combustion, prevent the deposition of water on the glass, causing the lamps to burn with a pure white flame, and increasing the brilliancy and effect of the light. The consumption of oil is of course increased, but not to a higher average than is stated to be used in the English lights. This fact of the increased consumption of oil has been very erroneously attributed to some peculiarity in the lamps, and an assertion has also been made, that the lamps are constructed on the "carcel" principle. (See Doc. 811, 27th Cong., 2d ses., p. 21.) This assertion is, however, entirely incorrect, as the original model of the lamp now in the Fifth Auditor's office will prove, it being nothing more than a simple Argand fountain lamp, made in a substantial and workmanlike manner, and at the same price as the ordinary "contract lamp." The increased consumption of oil arises from the greater amount of ventilation, and it rests with the judgment of the keeper entirely, as to the quantity of air necessary for sustaining the combustion, which he can regulate with perfect nicety, if so disposed.

TIDE LIGHTS.

There were eight light-house stations examined on this survey, where the harbors are inaccessible at low water, three of the number being dry harbors, or those from which the tide recedes entirely, viz:

Newburyport, barred harbor.
Ipswich, do.
Squam, dry harbor.
Scituate, do.
Wellfleet, do.
Brant point, Nantucket, barred harbor.
2 leading beacons at Nantucket do.
1 leading beacon do. do.

These places all being inaccessible at half tide, or from that to low water, the lights are not only kept burning many hours every night at a useless expense, but to the immediate danger of strangers who approach them with a view to enter the harbors, and who may hazard the loss of their vessels by running on the bars when the tide is ebbing. It has long been the practice on the English and French coasts to light the lamps at tide harbors only at half flood, and to extinguish them at half ebb, or to light them when eight or ten feet water had flowed on the bar. This prudent measure not only saves a large annual consumption of oil otherwise burnt to waste, but prevents seamen from risking the safety of their vessels by approaching the shore at low water. There are a great number of such harbors in the United States, but the existence of a tide light is unknown to this day.

24 L H P
KEEPERS.

One of the most important steps, after establishing a light-house, is the selection of a suitable keeper; for upon him depends, in a great measure, the efficiency and steadiness of the light under his care; the more so as but one keeper is allowed to each establishment on our coast, excepting in the case of a few southern lights. Thus it becomes necessary for these functionaries to leave their beds at night to examine and trim their lamps, a sacrifice of personal comfort which few of them are willing to make. The usual routine of their practice consists in lighting up at twilight, and then trimming between 11 and 12 at night; after which, the lamps burn or not, as the case may be. It is, therefore, no uncommon occurrence to see a light gradually disappear between 3 and 4 o'clock of the morning. The best keepers are found to be old sailors, who are accustomed to watch at night, who are more likely to turn out in a driving snow storm and find their way to the light-house to trim their lamps, because in such weather they know by experience the value of a light, while on similar occasions the landsman keeper would be apt to consider such weather as the best excuse for remaining snug in bed. One of the greatest disadvantages attendant upon the obtaining of good keepers is the rate of salary allowed, which, in this country, will not command the services of intelligent men, such as are required to do justice to a valuable and costly apparatus, when such is intrusted to them. Another, and by no means the lesser evil, is the appointment or dismissal of keepers on the grounds of political faith or heresy. This branch of the public service ought at least to be free from such surveillance. Keepers are also allowed to act as pilots; many of them receive a much larger annual income from this source than from their regular salary, leaving their wives and children to manage the light. They take charge of every ship thrown within their reach, and incur the risk of an absence from their post for several days. Other keepers are active fishermen, and still more active politicians, leaving their proper duties to make speeches in some village tavern. The satisfactory discharge of the duties required to maintain a light-house in a perfect state of efficiency during the long watches of the night cannot be accomplished by one man. There are many reasons why this should be so. Take any of our coast lights for examples: suppose that during a storm a few panes of glass should be broken in the lantern, of course every lamp would most likely be extinguished. The keeper is probably in bed and asleep, and the light remains extinguished for hours, to the great danger of approaching vessels. Or suppose it be a revolving light, as another example, and the machinery ceases to operate, the light becomes a "fixed" one in effect, visible only in two opposite directions, and, when seen, likely to be mistaken for a fixed light, leading astray the unfortunate navigator.

These are but a small portion of the existing reasons why the number of keepers in our important coast lights should be doubled at least, and required to stand watch and watch in the lantern, for by this method alone can the lights ever be properly attended. No lamp in any light-house on this coast can burn more than four hours without trimming; and if it does, the amount of light yielded is of but little value. No
keeper should be allowed to act as a pilot, nor leave his duty for a single hour without providing a proper substitute. The salaries, as now fixed, are as unequal in proportion to the duty performed as are the arrangement of the lamps to the wants of navigation. Keepers who attend small harbor beacons have as much, and more, in some cases, than those who attend the great coast lights. One keeper will have a handsome farm, in addition to a higher salary than another who is located on barren sands or rocks. The tariff of salaries among these voluntary exiles ought certainly to be regulated with reference to the natural advantages appertaining to each locality, to the amount of duty to be performed, (referring to the size of the lighting apparatus,) and to the relative importance of the light they each superintend. Many keepers are compelled to endure extreme suffering from the wretched condition of the dwellings, from the want of a good boat, or any boat whatever, and from the absence of any means of obtaining pure water on the premises. If the Government neglects to furnish keepers with what common humanity demands, it cannot be expected that this humble yet useful class of citizens should be so devoted to the discharge of their duties as if provided with homes that it would be their pride to maintain in perfect order and cleanliness. The proofs of the moral effect produced upon keepers under the opposite conditions stated were strikingly visible in numerous instances. Those who had a decent roof to cover their heads appeared industrious and happy, their houses neat and comfortable and their lanterns in perfect order, while those whose homes were in a state of partial ruin, who have a rickety lantern and apparatus to attend, a leaky roof over their beds at night, and who are compelled to seek their daily supply of fresh water among the hollows and clefts of the rocks, had a look of squalid wretchedness about them; their houses and lanterns were filthy and unclean, and their families ragged and dirty.

In England and France, all the important coast lights are attended by two or more keepers. On the French coast, not less than four keepers are appointed to each first-class light, while two and three attend the second and third class. It is in harbor beacons alone that one keeper is considered sufficient.

FOG-BELLS AND GONGS.

These machines are of great value to navigation on a coast like that of New England, where dense fogs are so often prevalent and of such long duration. A good clear bell or sonorous gong can be heard, when properly used, some five or six miles, even amid the howling blast of a northeast snow storm.

There are four fog-bells on the coast of Maine. The one at West Quoddy Head light is suspended so as to admit of rotary motion when rung by hand or is tolled by a hammer moved by machinery. By the first method it can be heard five miles; by the last its tones are lost in the roar of the surf.

At Whitehead island a tide machine, invented by Morse, was put in operation some two years ago, but failed entirely, being several times
damaged by the surf. The only point attained by the use of this invention was, the winding up of the motive weight to the tolling machine. The keeper at this place has adopted the novel expedient of attaching a line to the clapper or tongue of the bell, the other end of which leads through a hole in the window of his bed chamber, and amuses himself after retiring for the night with tolling an hour or two.

At Seguin island there is a very heavy bell on the summit of the island, near the light-house, which is tolled by hand alone, and it therefore cannot be heard above the booming of the surf, even in calm weather.

At Cape Elizabeth there is a bell which is tolled by machinery, and this cannot be heard far outside the reefs, unless with an off-shore wind, when the fog disappears, and the sound is no longer required.

A great deal of money has been expended upon these four machines, without deriving much benefit from them. The substitution of powerful gongs, and a machine capable of moving a drumstick with force and rapidity, would produce a sound far more reaching than the present bells in use, as it is well known that the vibrations of those instruments are more easily excited and prolonged than anything of the kind applied to the purposes of making noise.

It is somewhat remarkable that the important harbors of Boston, Portsmouth, Salem, and many others, should be left to this day without a fog-bell attached to some one of the light-house stations. Fogs of great density are by no means rare in Massachusetts bay, and the difficulty of steering a true course by compass, in such weather, is almost impossible, owing to the effect of tides and currents. The establishment of a fog-bell or gong at Boston light-house would be of great value and utility to the pilots and coasters, though not unless fitted up with more mechanical skill than those now used upon the coast of Maine.

BEACONS AND SPINDLES, OR SEA-MARKS.

The beacons on the coast of Maine are constructed of granite, in the form of four-sided pyramids, cones, and obelisks. Some of them appear to have been located more for the convenience of contractors out of work than to benefit navigation. For example, there is one very comfortably hidden in the close harbor of Castine, another in the close harbor of West Thomaston, a third in Goose river, while the dangerous passage of the Muscle ledges, and the various sunken ledges of Penobscot bay, and a host of other places, are destitute of any mark, whether beacon, buoy, or spindle. The beacons have mostly been erected to satisfy local interests, while their importance as national works, affecting the safety of navigation, seems to have been entirely overlooked.

There is one beacon on this coast, however, which is a credit to its constructor, and of great utility to navigation. This is the cast-iron beacon on York ledge, the design having been copied from the Carr Rock beacon, coast of Scotland, designed and erected by Robert Stevenson, Esq., engineer of the Bell Rock light-house. (See drawing.)

York Ledge beacon was erected three years since, by A. Parris, Esq., "architect and engineer," who is believed to be the first "professional man" employed on works of this description. It will undoubtedly
stand for centuries, an honorable testimonial of the skill and energy of its constructor.

There are numerous other dangerous ledges on the coast of Maine, that require similar marks to designate their positions.

**SPINDLES.**

There are also upon the coast of Maine sixteen iron spindles, or marks, to indicate the positions of sunken rocks. These spindles are located in the rivers and harbors, but the dangerous sunken rocks that abound in all the bays and narrow channels are left without any such marks. In the Muscle Ledge passage there are several very dangerous sunken rocks that lie directly in the track of vessels, and scarcely a day passes that some vessel is not seen hard and fast upon them.

In Owl's Head channel, Fox Island passage, and the centre of Penobscot bay, are also sunken rocks that frequently bring up vessels, and are the cause of serious losses and disasters. Of the sixteen iron spindles above named, three are in Castine harbor, ten in Kennebec river, one in Penobscot river, one in Whitehead harbor, one on Mark island, Harpswell bay, and none in the most-frequented channels and thoroughfares, where thousands of vessels annually pass through.

There are two beacons of granite within the harbor of Portsmouth, the only ones within the limits of the coast of New Hampshire.

In the harbors of Massachusetts there are twenty-five beacons, nearly all constructed of blocks of granite, laid up in square triangular or conical pyramids, while the dangerous reefs and sunken rocks outlying the main land have no marks upon them, except the few that are provided with buoys. The rock off Cape Ann, known as the Londoner, and which is bare at half tide, picks up a great many vessels in the course of the year. Only the day before my arrival at Thacher's island, a total loss occurred there. It is true that beacons are essentially necessary in many of the harbors; but it is also evident that the immediate danger resulting from the wreck of a ship on one of the exterior reefs is incomparably greater than if such an accident occurs within the limits of any harbor, where assistance and rescue are always at hand. There are five beacons in Boston harbor, but not one on the outlying reefs, such as the Cohasset rocks, Harding's ledge, the Graves, Fawn bar, and other dangers. In Salem harbor there are nine beacons, in Beverly three, and Marblehead two—making 15 beacons within the approaches to Salem.

The construction of beacons on the coasts of Maine, New Hampshire, and Massachusetts, is nearly similar in every instance, the only variation being in their forms. They are built of granite dimension stone. In some cases the beds and builds are hammered, in others rough-split. The square and triangular pyramid are the common forms, and but two of a conical figure were examined—one at Winter harbor, and the other in Boston harbor. By adopting the square and triangular base for these structures, they are frequently demolished by floating ice grinding against the angles, and dislodging the masonry. Some of the beacons are merely a cob-work of granite blocks. No preparation is made
for a foundation, or by levelling the site for the reception of the base course of masonry; but like the light-house towers, they are erected on the natural surface, uneven, or not, as the case may be. It was in consequence of neglecting this essential part of the work, that a contractor employed to erect the beacon at Winter harbor, near Saco river, lost his life—one-half the base resting on a shelf of rock, the other on gravel and sand, and when the structure was nearly completed, it fell, owing to the settlement of the base courses in the gravel, and buried the unfortunate contractor in the ruins.

The substitution of cast-iron beacons for stone would be attended with every advantage, as to economy and durability. The Government have sustained immense losses in the destruction of stone beacons by storms and ice, and the recurrence of such losses can only be avoided by bestowing more care and greater outlay upon their construction. The adoption of the screw-pile used in England for such purposes, would also be attended with great utility and economy, wherever the nature of the bottom allows. The shoals of Nantucket are undoubtedly the most dangerous portion of the New England coast, and are without even a buoy to mark their locality. The erection of screw-pile beacons on these shoals is perfectly feasible, and the whole could be effected in one summer. The South shoal of Nantucket has been the horror of American navigators generally for the last half century, and yet at this late day they are ignorant of its exact locality. The erection of a screw-pile beacon on this shoal, as also on the several rips to the northward, would be a blessing to our whole commercial navy.

BUOYS.

There are seventy-one buoys located in the waters of Maine; nine in Portsmouth harbor, coast of New Hampshire; and one hundred and thirty-seven in Massachusetts—total, two hundred and seventeen. These are all spar buoys, except two in the neighborhood of Eastport, which are can buoys. The spar buoys vary in length from twenty to fifty feet, and are moored by means of a large block of stone secured to the heel of the spar by an iron strap with a swivel joint. The length of the spar varies as the depth of the water in which it is placed, from ten to twenty feet being visible above the line of high water. The position of the spar varies as the height of the tides. At high water they tend nearly erect, from the greater amount of immersion. At low water they rake considerably, so that, if a heavy sea is running, we cannot distinguish them readily, but at short distances. These buoys are painted of three colors—black, red, and white. But few of the seventy-one buoys on the coast of Maine are painted of any color, except some in the neighborhood of Portland. Twenty-six of these are located in the Kennebec river, while numerous dangers on all parts of the coast, particularly in Pownobscot bay, are left unnoticed. In Salem harbor there are forty-nine buoys, thirty-four of which are black, seven white, and eight red. The object of painting buoys is to enable the pilot or navigator who falls in with one in thick weather to know on what danger it is placed, so that he can steer accordingly; but it is evident, from the number of black buoys mentioned in Salem harbor, that
they might as well be of any other color, so far as it is used in a distinctive way. There is the same want of system in the arrangement, color, and location of buoys throughout the coast and harbors of Massachusetts. The dangerous rocks off Hampton harbor, Newbury, Ipswich bars, the Salvages, Straitsmouth channel, and Thacher's Island reefs, are all naked, while Salem harbor and precincts have not less than forty-nine buoys, Lynn harbor eleven, and Boston harbor twenty-seven. There are fourteen black, nine red, and eight white buoys in Boston harbor. The colors, instead of alternating successively in the order of position, or by some other equally plain and easy mode of distinction, are not arranged with any such view. It seems to have been considered sufficient to locate the buoys, leaving those who depend upon them for safety to find out as they can what particular danger is indicated. The spar buoy is the least expensive of any in use, and if well moored, and properly distinguished by painting, or marks attached to the head, is as suitable to the purposes of navigation as any other. But these conditions are not well fulfilled on our coast, else it would hardly require $25,000, annual appropriation, to keep up the establishment. Every severe gale of wind, and every field of floating ice, carries off a greater or less number of these buoys, and considerable time must elapse before they can be replaced. If they were suitably moored, such losses would rarely occur. The use of screw moorings are yet unknown in this country, while England has availed herself of this valuable invention, and not only retains her buoys and floating lights at their stations, but also as a means of founding light-houses and beacons upon shoals hitherto considered inaccessible to the engineer.

These moorings involve a greater expenditure at the outset, which is fully compensated for by their immovability. The systematic coloring and marking of buoys in the British coast, together with the official and descriptive catalogues published and issued at the various seaports, for the information of seamen, is a feature of administration that might be copied with advantage to the commerce of this country.*

There are many places where the introduction of beacons, constructed on the screw-pile plan, would be of the greatest benefit to navigation, particularly in the Vineyard sound, and about the Shoals of Nantucket, the Pollock rip, &c. These shoals are exceedingly dangerous and pick up great numbers of vessels.

---

*Light-houses and beacon-lights required on the coasts of Maine and Massachusetts.*

**LITTLE RIVER HARBOR.**

In steering for Passamaquoddy and the Bay of Fundy, there is no available harbor, after passing Machias bay, between Little river and West Quoddy head. This harbor of Little river is easy of access, sufficiently capacious for a large fleet, and the anchorage secure from all winds. The location being at the mouth of the strait leading into the
Bay of Fundy, where the rapidity of the currents and prevalence of dense fogs render the navigation very hazardous, coasters of all classes, as well as British timber ships, are very glad to avail themselves of this convenient haven, where they can await in safety the return of fine weather and fair winds. The rocky coast east of Little river has two considerable indents, called Moose Cove and Baylie’s Mistake, both of which are lined with reefs, and most unsafe to enter, affording no shelter, and, from their peculiar resemblance in outline to the rocky headlands of Little river, have been the cause of fatal disasters. There is no place on the coast of Maine where a light would be so truly serviceable as upon the island at the entrance of this harbor, a small beacon-light being alone required. This would at once prevent the recurrence of wrecks at Moose Cove and Baylie’s Mistake. There is already a fine village at Little river, with extensive tide mills for sawing lumber, and a large fishery.

**GREAT DUCK ISLAND.**

A coast light is much needed on this island, which is the most prominent point at the entrance of Petit Menan and Frenchman’s bays. A light here would show the entrance to Mount Desert harbor as well as Bass harbor. It would prevent wrecks upon the reefs of Long island, and be a safe point of departure for all the coasting trade. Baker’s Island light is some five miles to the northeast of this island, and its utility to navigation is somewhat questionable. It is not a commanding or salient point, like Duck island, nor does it afford a channel course to steer by, except through Bass Harbor straits, where the land is a better guide than any light. If Baker’s Island light were suppressed, and one established on Duck island, the coasting trade would be much benefited by the change.

A small beacon-light is required at the entrance of Gouldsborough harbor, which is one of the most spacious and secure among the many on this coast. There is a dangerous reef lying off the entrance, called Morton’s ledge, and no guide by which to clear it, and find the entrance to the harbor at night.

A small beacon-light is required at the entrance of Wells harbor, and another at the mouth of York river.

A single-lamp beacon is much required on the southeast angle of Fort Warren, Boston harbor, to assist the pilots in finding the entrance to the Narrows channel, and avoiding the rocks off George’s island.

**MINOT’S LEDGE, COHASSET ROCKS.**

A light-house on this reef is more required than on any part of the seaboard of New England. The loss of lives and property here have been annual, and will continue to occur until a light is established, and the one at Scituate suppressed. A wreck on this fatal reef is always attended with the destruction of human life, owing to its great distance from the shore, and the tremendous sea that rolls in over the rocks when the wind is at the eastward.
Siasconsett, Nantucket.

On the eastern side of Nantucket island there is a deep safe channel inside of all the shoals and rips. The erection of a light on the high land near Siasconsett would not only render this valuable channel available to all classes of shipping, but would be, if sufficiently elevated, a safe mark, in clear weather, to clear the South shoal, twelve miles distant, and all the rips to the eastward.

Block Island Channel.

A light is wanted, either on No Man's Land island, or on the south side of Block island, to assist the southern coasting trade in entering through Block Island channel to Vineyard or Long Island sounds, and Narragansett and Buzzard's bays.

Old Cock, Hen, and Chickens.

A light on the Hen and Chickens reef, at the entrance of Buzzard's bay, is much needed, not only to keep vessels off this reef, but to enable them to clear the long reef of Sow and Pigs, on the opposite or eastern side of this bay. The light on Cuttyhunk is comparatively useless in its present location.

Palmer's Island.

This island lies directly within the entrance to New Bedford harbor. A single-lamp beacon placed upon it would add materially to the facilities required on entering this important harbor.

Harbors.

The State of Maine is more bountifully provided with deep, safe, and capacious harbors than any other in the Union. There are some, however, that require breakwaters and other protective works. Portland harbor is the most important, from being the principal commercial depot of the State. One breakwater has already been constructed there, which, though it serves to check the heavy swell of the sea from the southeast, yet acts injuriously in other respects, by obstructing the flow of the tides, and causing a rapid accumulation of silt, &c., within the harbor, with a consequent decrease in the depth of water. Another evil complained of by the merchants of this city, arising from the same source, is that the breakwater prevents the ice formed in the harbor from being drifted out by the ebb tide; and yet another evil is, that, though protected from the ocean swell on one side of the harbor, still the other and more exposed side, open to the northeast storms, is without any breakwater, though in their opinion the northeast side should have been first protected, owing to the greater frequency of severe storms from that quarter. A breakwater is much needed at East Thomaston, this harbor being open to the rake of easterly storms. Safe harbors of refuge for the coasting trade might be made at Wells and York river, by the construction of suitable piers of masonry; and it should be recollected there
is no harbor accessible at low water between Portsmouth and Portland. Portsmouth is the only harbor of any capacity on the seaboard of New Hampshire. It is well known as one amongst the best, though rather dangerous of access.

The harbors of Massachusetts are few in number, considering the great linear extent of her coast. Newburyport is a barred harbor, of difficult access, and, being the embouchure of a considerable river, will always remain barred. The same may be said of Ipswich. Annisquam is a dry harbor, only used by the small craft owned there, except now and then some stranger is driven in during a storm. Rockport, or Sandy bay, would become a fine harbor with a suitable breakwater to check the northeast swell, to which it is entirely open. Gloucester harbor is a good one, when safely in it, though too small ever to be frequented by fleets of shipping. The outer harbor has been the scene of some horrible disasters. Salem harbor may be considered as nearly lost for the purposes of commerce, by the rapidity with which it has been filled up during the present century. Ships of large tonnage are now obliged to lighten their cargoes in and out. Marblehead is a snug harbor, but unsafe in easterly storms. It could be effectually protected by a breakwater.

Boston harbor, the most important one in New England, is in a fair way to be most seriously injured by the accumulation of silt and gravel in the main ship channel, or Narrows, which have already become so shoal, that a pilot informed me some caution was necessary in taking large ships through at low water. The numerous islands in the outer harbor of Boston are all in a state of decay, through the action of the severe easterly storms prevalent during three-fourths of the year. These islands are all of the diluvial formation, the mass being composed of gravel, sand, and loam, with boulders interspersed. Large portions of the sea-fronts of all these islands are annually split off by the combined action of moisture and frost. This detritus falling on the beach is rapidly swept away by the tides, and a large portion of it deposited in the Narrows channel, where the meeting of several currents produces eddies that allow of the subsidence of the matter before held in suspension. The points which contribute the largest share to this bank of deposit are, on the north side of the ship channel, the Great Brewster, Lovell's island, and Deer island; on the south side, Point Alderton, Gallup's island, and Long Island head.

In addition to these several spots from whence deposit is removed by the tides and conveyed into the ship channel, there are numerous others. For example, all the silt brought down by the ebb tides from Hingham bay, Braintree bay, Quincy bay; all the gradual washings from the beaches of the numerous inner islands; all the detritus and silt brought down by the Charles and Mystic rivers. Each of these contributors finally meet in some part of the Narrows channel; and if some steps are not taken to avert this impending trouble, the main entrance to Boston harbor may be destroyed or seriously obstructed. I know, from actual measurement, that the width of the channel between Lovell's island and Nix's Mate has rapidly decreased within three years past; and discovered this fact by striking the bottom with only eight feet draught, where three
years since I could have carried nine feet at the same stage of the tide. This was on the spit making off on the east side of Nix's Mate, and which has rapidly grown by the daily additions of detritus brought down by the ebb from Long Island head. If Long Island head, Nix's Mate, and Gallup's island, were connected together by a rough breakwater, and a similar construction extended from the northwest shoal (part of Lovell's island) to the firm shore of that island, and then again from the southeast point of said island to the beacon on the spit of the Great Brewster, the velocity of the ebb tide through the Narrows channel would not only be sufficient to scour out all the accumulation of twenty years past, but, by closing up the openings which now produce the eddies and counter currents, cause the deposit of sand, gravel, &c., to take place at a sufficient distance from this channel, to prevent future mischief. A glance at the accompanying chart of Boston harbor will show that the Narrows channel has not less than five openings into it; and it is well known to our pilots that at half flood or ebb the tide sets through the Narrows in opposite parallel directions.

To stop the decay of the numerous islands (which are mostly private property) would be a work of enormous cost, and altogether impracticable. The public work on Deer island may be taken as an example of the futile efforts of man, when he attempts to combat nature. If a law should be passed enacting severe penalties upon any one who should remove even a single stone from the beaches of these islands, it would be one step towards arresting the evil produced by their decay. At present, all the shipping of Boston is supplied with ballast from these very beaches; and the Great Brewster is one of the most favorite resorts of the ballast mongers, its beach being robbed of every sizable stone brought down from the banks above. If these stones and boulders had been allowed to accumulate for a series of years, the surf would have thrown them up into the form of a breakwater—thereby protecting the base of the gravel banks from the wash of the tides, and retaining whatever should fall down from above.

A complete hydrographical and topographical survey of Boston harbor is imperatively demanded at the present time. It is due to the commercial interests of this great city, where a large amount of revenue is annually collected; and no trustworthy plan for averting the evil which now threatens this important seaport can safely be offered until such survey is executed, and a thorough knowledge of the various causes of mischief now operating thereby be obtained.

Another great benefit may be conferred on the port of Boston by such a survey. The entrance through Broad sound is at present imperfectly known, and not even properly buoyed out. A few years may render this the only safe entrance; and it would much facilitate the purposes of navigation, if all the shoals and dangers lying within it were carefully examined and marked by buoys and beacons.

Scituate harbor is dry at low water, and only frequented by the small craft owned at that place, though several instances have occurred where vessels, mistake the light for that at Boston, have run in and found themselves suddenly hard and fast in the mud.

Plymouth harbor is spacious and easily accessible, but requires an
iron-spur beacon on the Gurnet rock, and a screw-pile beacon on the
dangerous shoal ground of Brown's island.

Barnstable and Wellfleet harbors are obscure, and only frequented by
vessels owned at each place. A screw-pile beacon on the tail of Sandy
Neck shoal, at the entrance of the former, and one on the extremity of
Billingsgate Island shoal, at the entrance of the latter harbor, would be
of the greatest utility to all the navigators of Cape Cod bay.

Provincetown harbor is one of the best in the Union—spacious, deep,
and accessible at all times without a pilot.

Hyannis harbor requires for its completion the further construction
of the breakwater commenced some years since.

A very useful and necessary harbor could be formed at Great point,
Nantucket, by extending a breakwater from said point to the westward.

Edgartown harbor is the only safe one, accessible at low water, in the
Vineyard sound; and this harbor will in a few years be so filled up as to
become useless, unless some measures are taken to stop the present ac-
cumulation of shallow ground. A breakwater, of 1,200 feet in length,
is required to keep the sand and silt from washing into the harbor.

Treasury Department, June 3, 1842.

Sir: I have the honor to submit, for your consideration and opinion,
the question as to the powers of the Secretary of the Treasury to insti-
tute a survey of the light-house establishment, under the appropriation
act of the 16th ultimo, which contains the following provision:

"For expenses of examining and reporting the condition of all the
light-houses, annually, $4,000."

The light-house establishment was placed under the control of this
Department by the act of 7th August, 1789, and was under the personal
supervision of the Secretary of the Treasury until after the passage of
the act of 8th May, 1792, (vol. 2, p. 304,) which created the office of a
commissioner of revenue, who was charged with "superintending, under
the direction of the head of the Department, the collection of the revenue
of the United States, and shall execute such other services, being con-
formable to the constitution of the Department, as shall be directed by
the Secretary of the Treasury."

The light-house establishment was placed under his supervision by the
Secretary of the Treasury.

This office was discontinued on the 6th of April, 1802, (vol. 3, p. 479,) and
again revived on the 24th July, 1813; and this act specified that
"he shall execute the services with respect to the light-houses and other
objects which were usually performed by the former commissioners of
the revenue."

On the 23d December, 1817, (vol. 6, p. 251,) this office was abolished,
and no special provision was made for the superintendency of the light-
house establishment, which devolved again on the supervision of the
Secretary of the Treasury.

On the 9th April, 1818, the following is the item of appropriation
relying to the lighthouse establishment, and which is the usual form in which all like appropriations have been made since that time:

"For the maintenance and support of light-houses, beacons, buoys, and public piers, stakeages of channels, bars, and shoals, including the transportation and purchase of oil, keepers' salaries, repairs and improvements, and contingent expenses, § 60,236."

The office of Fifth Auditor was created on the 3d March, 1817, and his duties are thus prescribed: "The Fifth Auditor shall receive all accounts accruing in and relating to the Department of State, and those arising out of Indian affairs."

The superintendency of light-houses, now held by Mr. Pleasonton, was conferred on him by no act of Congress, but rests simply and solely on a Treasury instruction. Mr. Pleasonton, in a letter addressed to me on the 18th of October last, writes: "In place of the accounts of Indian trade which ceased and were transferred, a much more important and responsible duty was assigned me on the 1st of January, 1820, by the Secretary of the Treasury, under the law for the abolishing the office of the commissioner of revenue. This was the care and superintendence of the lighthouse establishment."

On the 23d of May, 1828, (vol. 8, p. 63,) it was enacted: "That the Secretary of the Treasury be, and he is hereby, empowered to provide by contract for building light-houses and erecting beacons on the following sites and shoals, &c." The 3d section empowers the Secretary of the Treasury to pay certain salaries. The 4th section gives the Secretary of the Treasury the power to regulate and fix the salaries of keepers of light-houses, &c.

The same language is adopted in acts of 2d March, 1829, (vol. 8, p. 200,) and 3d March, 1831, (vol. 8, p. 490;) act of 30th June, 1834, (vol. 9, p. 97;) act 3d March, 1835—and is the usual form of such appropriations.

Such are the laws and facts of the case.

An appropriation of §4,000 has been made for a survey of all the light-houses of the United States. Being desirous of having this survey of the whole coast of the United States made by a scientific and experienced agent, and the power of the Secretary of the Treasury having been questioned, I beg leave to submit the question for your consideration.

An early reply is respectfully requested.

Very respectfully, your obedient servant,

W. FORWARD,
Secretary of the Treasury.

Hon. H. S. LEGARE,
Attorney General of the United States.

Office of the Attorney General,
June 4, 1842.

Sir: I have had the honor to receive your letter of the 3d instant, submitting for my consideration and opinion "the question as to the powers vested in the Secretary of the Treasury to institute a survey of
the light-house establishment, under the appropriation act of the 16th ultimo," which contains the following provision:

"For expenses in examining and reporting the condition of all light-houses, annually, $4,000."

All the acts for the collection of the revenue must be read together, as in pari materia, and composing a complete system.

The general laws of the session of 1789, passed just after the formation of the Government, are all more or less fundamental, and serve as legislative expositions of the different provisions of the Constitution to which they respectively relate.

The act of 7th August, 1789, for the establishment and support of light-houses, expressly assigns to the head of the Treasury Department the power and the duty of building, rebuilding, and keeping in good repair, all light-houses, &c. Clearly, under this act, the expenditure of an appropriation for examining and reporting annually the condition of light-houses, i.e. of looking into them with a view of keeping them in good repair, would be incidental to the general charge imposed by that statute upon the head of the Treasury Department.

But none of the subsequent acts on the subject make any change in the system; on the contrary, they uniformly re-enact, in particular cases, the general provisions just referred to of the act of 1789.

That the Treasury Department has confided the function of superintendence of light-houses, for which its head is responsible, to this or to that one of its subordinates, can make no difference, in the absence of any express statute to that effect, inconsistent with the act of 1789. I know no such statute.

As to the Commissioner of Revenue, the act of 23d December, 1817, section 2, provides that his office shall be discontinued; in which case the immediate superintendence of the collection, &c., shall be placed in such officer of the Treasury Department as the Secretary for the time being shall designate.

This was in strict analogy to the original constitution of the office of commissioner by the act of 8th of May, 1792, by which that officer was to discharge the duties assigned him by law, under the direction of the Secretary, and execute such other duties, &c., as the Secretary should order.

It was in conformity with this provision that the head of the Department, in his discretion, delegated to the commissioner the duty incumbent on that head in relation to light-houses.

But the power of delegating implied a right of reverter, and the mere abolition of the office of commissioner, without more, devolved the functions thus committed to it upon the Secretary, and revived his direct responsibility in regard to them. This conclusion is fortified by the clause just cited from the act of 23d December, 1817.

On the whole, I am satisfied the Secretary is bound to see the appropriation in question expended in conformity with its true object and spirit.

I have the honor to be, sir, your obedient servant,

H. S. LEGARE,
Attorney General, United States.

Hon. WALTER FORWARD,
Secretary of the Treasury.
COMPTROLLER’S Office, January 17, 1843.

SIR: Your letter of the 30th ultimo, with the accounts of I. W. P. Lewis, Esq., “for the expenses of the survey of light-houses, ordered by the Secretary of the Treasury on the 25th May last,” has been received.

I have duly considered your objection to its allowance. The 25th section of the act entitled “An act legalizing and making appropriations for such necessary objects as have been usually included in the general appropriation bills without authority of law,” &c., in my opinion refers entirely to extraordinary and novel commissions or inquiries, but not to the examination of light-houses, for which a specific appropriation has been annually made, that was heretofore used to defray the expenses of numerous surveys made by collectors, but which might with equal propriety, and perhaps more benefit, have been disbursed for a general survey, as in the case of the one recently made by Mr. Lewis.

The superintendency of the expenditure of the usual annual appropriation of $4,000, made in the general appropriation acts, “for the expenses of examining and reporting the condition of all the light-houses, $4,000,” being by law devolved expressly on the Secretary of the Treasury, it must necessarily be expended as he shall deem best for the public service and the accomplishment of its object; and if I had entertained any doubts on this subject, which I did not, they would be removed by the opinion that the Attorney General has expressed on this question, and in which he says: “The act of the 7th of August, 1789, for the establishment and support of the light-houses, expressly assigns to the head of the Treasury Department the power and duty of building, rebuilding, and keeping in good repair, all the light-houses, &c. Clearly, under this act, the expenditure of an appropriation for examining and reporting annually the condition of the light-houses, i.e. looking into them with a view of keeping them in good repair, would be incidental to the general charge imposed by that statute upon the head of the Treasury Department.

“But none of the subsequent acts on the subject make any change in the system; on the contrary, they uniformly re-enact, in particular cases, the general provisions just referred to of the act of 1789;” and, in conclusion, that he, the Attorney General, is on the whole satisfied, the Secretary is bound to see the appropriation in question expended in conformity with its true object and spirit.

I have therefore to request that you will report on the accounts of Mr. Lewis, for my approval, as early as may be convenient.

With great respect, your obedient servant,

J. W. McCULLOH, Comptroller.

Hon. TULLY R. WISE,
First Auditor of the Treasury.
WASHINGTON, May 24, 1842.

SIR: Congress having made an appropriation for the examination of light-houses, I wish to call your attention to the manner of the examination, it being, in my opinion, entirely at your discretion. From the commencement of the Government to the present time, there has never been a scientific survey made of the light-houses of the United States. From an investigation of the condition of the system, the vast amount annually required for repairs, &c., I am convinced that a thorough examination of every light-house, beacon, &c., by a man of experience, is necessary, and would give to your Department and to Congress a mass of valuable information, and also point out the many radical errors which seemingly without doubt exist. By appointing such a person, with instructions to visit the whole coast of the United States, and to report the result of his examinations, you will confer a lasting benefit on the country, and put in the legislative power the data necessary for the correction of existing abuses, and, if it should be deemed advisable, of remodelling the whole system.

Knowing your deep anxiety to correct error and to aid in the introduction of salutary reforms, I deem it useless to enlarge upon the importance of this subject. I would recommend to you, as a person eminently qualified to make the examination, Mr. I. W. P. Lewis. He has formerly been engaged in this branch of the public service. I know him to be an honorable, honest, and competent man. He is one of the very best engineers in the country, and intimately acquainted with the light-house systems of France and England, and well versed in all the improvements lately introduced into those countries. He fitted up the light at Truro; and, in short, I have letters which assure me that, in every particular, his qualifications are of the first order.

I hope, sir, that you will immediately secure Mr. Lewis's valuable services, which may be the means of saving millions to the Treasury of the nation. You are aware that I seldom recommend any person to office, and scarcely ever suggest anything appertaining to the duties of the various heads of Departments; and you will therefore be assured that nothing but my deep conviction of its importance, and the benefits which I believe will be derived from it, have now impelled me to trespass on your valuable time, and to beg your earliest consideration of my hastily written opinion.

With very great respect, your obedient servant,

GEORGE H. PROFFIT.

Hon. WALTER FORWARD, Secretary of the Treasury.

SPRINGFIELD, June 8, 1842.

Having been called upon to state the opinion which I entertain of the ability and character of I. W. P. Lewis, Esq., civil engineer, I can with entire confidence say, from personal knowledge, that, in addition to his acquirements as a civil engineer, his qualifications as an architect are of the highest order.
I also know, from the length of time and attention which Mr. Lewis has devoted to the subject, that the information which he possesses in relation to light-houses, illuminating apparatus for the same, beacons, buoys, &c., both in this country and in Europe, is greater than that of any other person of my acquaintance. His knowledge, both theoretical and practical, in this branch of his profession, is invaluable.

W. H. SWIFT,
Captain, Topographical Engineers.

FALL RIVER, June 4, 1842.

SIR: I have been informed that you have appointed Mr. I. W. P. Lewis, of Boston, a commissioner to examine into the present condition of all the light-houses upon the coast of the United States, and that since Mr. Lewis's appointment some persons have doubted his competence to discharge the duties in a proper manner. As it respects Mr. Lewis's qualifications, I would state that, in the course of my employment in making the Massachusetts State survey, I have had occasion to visit almost every light-house upon the coast of Massachusetts, and have also witnessed the improvements introduced by Mr. Lewis into the Boston and Cape Cod light-houses, which, together with something like an intimate acquaintance, I feel no hesitation (so far as I am competent to judge of the subject) in recommending Mr. Lewis as a person well qualified for the discharge of that trust. In fact, sir, I have felt, since I have heard of the appointment, that you have been peculiarly fortunate in finding so competent a man. I will not say that it will be impossible to find other persons who would be as competent to perform the services; but I will say that no person with whom I am acquainted is better qualified, or even as well.

Connected with this examination, I am informed that it is contemplated that something should be done by way of determining the latitude and longitude of the light-houses, approximately, or as near as can well be done in the short period which will be devoted to this survey and examination, by the aid of chronometers and suitable astronomical instruments. This trust, I also think, may be safely committed to his charge. I therefore hope that no obstacles will be thrown into the path of Mr. Lewis.

Having no doubt but that your honor fully comprehends the advantages which will accrue to the mariner who navigates our coast from every step that is taken which will have a tendency to furnish him with more accurate knowledge than he has heretofore possessed of the true latitudes and longitudes of all such remarkable points, headlands, light-houses, &c., which can be readily recognized in his voyages, and which will serve him the important purpose of regulating and determining the rates of his time-keepers, and will also furnish him with new points of departure, from whence he may commence the reckonings of his voyage as it were anew, it will be useless for me to say more upon this subject.

With much respect, your humble servant,

SIMEON BORDEN.

Hon. WALTER FORWARD,
Secretary of the Treasury of the United States.
Boston, June 3, 1842.

My Dear Sir: I have learnt with much pleasure that you have been appointed by the Secretary of the Treasury to make an examination of the various light-houses in the United States, in order that a more perfect system may be adopted, not only in their construction, but to report a more efficient organization of the whole system. This measure, in my opinion, is one which will be attended with very beneficial results; and if, during this examination, measures should be taken to determine their exact position, (viz: their latitude and longitude,) it would be still more desirable, for I believe that this important step has not yet been as carefully attended to as it should have been.

It is well known that large sums are annually appropriated for the erection and maintenance of these light-houses, and no one, who considers for a moment their great importance and absolute necessity for the security and safety of our commercial and military marine, would for a moment wish this branch of our national expenditure lessened, provided the money is judiciously expended; and how can this be known, unless by an examination by some competent person who has not been interested in their construction, who, after a careful survey of the whole coast, and an examination of the adaptation of each particular structure to its own immediate locality, shall be able to point out the defects, if any exist, and suggest such remedy as the nature of the case shall require. That you, sir, are fully competent to this task, no one who knows you can doubt, and from your business habits, mechanical skill, and scientific attainments, in my opinion, it could not have been intrusted to better hands; and I rejoice that we have a Secretary of the Treasury who is willing to break through established forms, and is independent enough to inquire for himself and seek for information from such sources as will not lead to error.

Should this measure, which I cannot doubt, be fully carried out, I have no question that a more economical system may be adopted, and the various stations be made much more serviceable than they now are, at much less cost.

I am, sir, with much respect, your friend and servant,

GEORGE DARRACOTT.

I. W. P. Lewis, Esq.

Quarantine, June 4, 1842.

Mr. I. W. P. Lewis was employed by the commissioners of health of the State of New York, and at the quarantine ground, for the period of six months in 1841. His duties were:
1st. To survey and direct certain excavations made there, with a view to filling in and making fifteen-sixteenths of an acre of new ground, and to lay out new roads.
2d. To repair the docks, which were much decayed.
3d. To build a new pier.
4th. To erect a boat-house and observatory.
5th. To cover the marine hospitals with cement.
Mr. Lewis planned and executed the above to our entire satisfaction, and with great economy, displaying good taste, and at the same time a scientific knowledge of dock-building and its collaterals. He likewise invented and constructed a lamp, with reflectors, for the quarantine light, differing from any lamp now used for a similar purpose. It gives a brilliant light, and is seen at a great distance, while the consumption of oil is extremely small. This lamp has been highly approved of by the pilots and masters of vessels entering the port of New York.

The ventilator placed by Mr. Lewis on the top of the boat-house was likewise planned by himself, and is an improvement.

A. SIDNEY DOANE,
Health Officer of Port of New York.

WILLIAM TURNER,
Health Commissioner, Port of New York.

JOHN W. FRANCIS, M. D.,
Resident Physician, New York.

CAMBRIDGE, June 9, 1842.

MY DEAR Sir: I have been requested to give my opinion in regard to the project of Mr. I. W. P. Lewis, for determining, by astronomical observations, the approximate positions of the light-houses on our coast. Allow me to say that the object is of paramount importance, and the opportunity which now occurs of doing it, in connection with the other survey of the light-houses, at a small expense, ought not to be allowed to pass without being used for this valuable service. Such an approximate determination by no means supersedes the more accurate trigonometrical coast survey of Mr. Hassler; but, as it will be many years before this survey is completed, some security should be given to our navigation in the mean time, such as is now proposed, and which can be effected at a small additional expense to the other engagements of Mr. Lewis.

Very respectfully, &c.,

JOSEPH LOVERING,
Hollis Professor of Mathematics and Physics
at Harvard University.

Hon. WALTER FORWARD,
Secretary of the Treasury.

CAMBRIDGE, June 2, 1842.

SIR: I have been desired to write you my opinion with regard to the expediency of examining and correcting the positions of the light-houses on our coast. Allow me to state, therefore, that I believe this enterprise to be capable of completion within a limited time, and at a moderate expense, compared with its great practical value, which will be universally understood and acknowledged by navigators. The great errors
and the still greater uncertainties of these positions are an inconvenience to commerce and a source of danger to seamen, which should be removed as speedily as possible. In a single clear night, at each station, a skillful observer, provided with proper instruments, would effectually accomplish this object, and at once reduce an error of miles to one of an unimportant fraction of a mile. I think, therefore, there is rarely an opportunity of conferring so great a benefit upon navigation and the country at so small an outlay of time and labor.

Most respectfully, your obedient servant,

BENJAMIN PEIRCE,
Perkins Professor of Astronomy and Mathematics
in Harvard University.

Hon. WALTER FORWARD,
Secretary of the Treasury.

TREASURY DEPARTMENT,
Fifth Auditor's Office, July 29, 1842.

SIR: I have just received your letter of the 15th instant, reporting the condition of each and all the light-houses in your district, and the conduct of the respective keepers.

I am very much surprised to find that the mortar with which the houses were built does not adhere to the stones, but crumbles and falls from the joints; and this I perceive is the case with all of them, the one at Portland included, which was built, I believe, when Maine was a colony of Great Britain. Of those which were built under my administration of the light-house department, the most of them were built under the immediate superintendence of Isaac Ilsley, Esq., who, I perceive, on reference to the contracts, always provided that good lime mortar should be used, and appointed two respectable persons to examine the work, and grant a certificate that the work was faithfully done before he made payment to the contractor. A certificate of this import was annexed to every contract, before payment was made; and the contract sent to this office.

These facts being so, it is worthy of inquiry whether the salt air and water, acting for a considerable time upon the mortar, may not destroy its adhesive quality, and decompose it.

Of the number built under General Chandler, he informed me that two or three of them were built so late in the season that the mortar was frozen before it was dry, and its adhesive quality was thus in a great measure destroyed.

Mr. Ilsley can inform you who the persons were whom he employed from time to time to examine the light-houses, after they were completed, and to certify as to the faithfulness of the work; and I must request you to obtain another statement from these persons, as to the good quality of the mortar at that time; and I must also request that you make inquiry, and furnish me with a statement, in writing, from experienced persons, as to the operation of salt water and air upon lime mortar.
Mr. Anderson, the late collector, I have no doubt, would aid you in this inquiry.

I perceive that you have left lime, paint, oil, &c., at the several light-houses, with which to make the repairs. This was all perfectly right; but as I am inclined to think the salt air will soon remove the pointing done with common lime, I would suggest the propriety of having all the pointing done with Roman or hydraulic cement. Propose this change to Mr. Libby, and get him to do the work as soon as you can. The lime left at the several light-houses may be used in whitewashing, mending chimneys, &c.

I am much pleased to learn that it occurred to you to carry paints, oil, lime, &c., with you to the different light-houses, and also to engage Mr. Libby to do all the pointing and mason work which was found necessary, as we shall thus have all the repairs made before the frost can injure any part of them.

I would be glad if you would ascertain when the Portland light-house was built, as I have nothing here to show that fact.

You did perfectly right, under the circumstances mentioned, to supply a boat to each of the light-houses at Boon island and Seguin; you will also supply the keeper at Mount Desert rock with a suitable boat, and dispose of and credit the amount received for the old one.

At a time when Congress is cutting down the salaries of all their officers, as well as their own compensation, it would be impolitic to recommend an increase of salary for the keeper at Saddleback ledge, although it might be just to do so. You will reconcile the keeper in the best way you can to his old salary.

As I am very desirous to know whether the mortar used in building the several light-houses was originally bad, or has since been injured by the sea, I must repeat my request that you will obtain and transmit to me all the information you can on the subject. You can ascertain from Mr. Ilsley, General Chandler,* and Mr. Anderson, who were the persons that inspected the several light-houses built during their time, and you will be pleased to apply to them for certificates on the subject, and also to the contractors, if it be practicable, for their depositions. As we have been charged with erecting bad buildings everywhere, and very probably the charge will be repeated, it is highly important that we should obtain correct information upon the subject.

You will have the necessary repairs made at Matinicus rock and Whale’s Back, if indeed you did not intend to include them in your estimate of aggregate expense.

I am, &c.,

S. PLEASONTON.

NATHAN CUMMINGS, Esq.,
Superintendent of Lights, Portland, Maine.

*General Chandler was dead, of which I was not aware.—S. P.
CONDITION OF THE LIGHT-HOUSES ON THE EASTERN COAST.

MARCH 2, 1843.—Read, and laid on the table.

Mr. Winthrop, from the Committee on Commerce, submitted the following report:

The Committee on Commerce, to whom was referred sundry communications from the Fifth Auditor of the Treasury Department, in relation to the existing condition of the light-houses on the Eastern coast, report:

The Committee on Commerce beg leave to submit sundry communications from the Fifth Auditor of the Treasury Department, in relation to the existing condition of the light-houses on the Eastern coast.

These papers have been received at too late a period of the session to undergo any careful examination, or to be made the subject of any specific recommendation. They seem, however, to contain much information, and many suggestions which may be valuable as the basis of future legislation, and which may contribute to a just understanding of the character and efficiency of our present Light-house Establishment. They should, accordingly, have a place among the public documents of Congress.

---

TREASURY DEPARTMENT,
Fifth Auditor's Office, February 13, 1843.

SIR: I have the honor to enclose, for the information of the Committee on Commerce, reports made by the superintendents of light-houses in Maine and Massachusetts during the last summer, as to the condition of the several light-houses under their superintendence, respectively, which show—

1. That the lighting apparatus generally is in good order, and that the keepers are attentive to their duty.

2. That the mortar used in the buildings constructed of split stone or hard bricks was made with fresh water and sand, in the belief that it was more adhesive than if made of salt water or sand; but that experience has proved that the action of salt water and salt air upon it, in a short time, has decomposed the mortar, and rendered it necessary that the joints be repointed, which has been done during the last year, with hydraulic cement, in regard to all the light-houses in the State of Maine.

3. That it appears, from the letter of Eliphalet Grover, who was appointed to oversee the erection of a new tower at Boon Island, to the superintendent of Maine, (page 15,) that, in taking down the old tower, which was built of mortar made partly with fresh and partly with salt water, it was discovered that the mortar made with the latter was the most firm and adhesive, and therefore more suitable for light-house towers.

Independently of the information contained in these reports, it may be useful to the committee to know that the average expense of the British
light-houses, for the year 1840, as laid before the Parliament and printed, was $8,602; and that the average expense of the light-houses of the United States, for the year ending the 30th of June, 1841, was $1,318, as will be seen by the paper herewith enclosed. The British accounts being made up to the close of each year, and ours to the close of each half year, the above comparison in point of time is as near as we can make it.

Should the committee wish to see the returns made by the other superintendents, in respect to the condition of their light-houses for the last year, they shall be furnished on an intimation to that effect being given.

I have the honor to be your obedient servant,

S. PLEASONTON.

Hon. John P. Kennedy,
Chairman Committee on Commerce, Ho. of Reps.

---

LIGHT-HOUSES.

Letter from the Secretary of the Treasury, transmitting a report of the Fifth Auditor in relation to the light-houses, &c.

January 10, 1844.—Read, and referred to the Committee on Commerce.

Treasury Department, January 6, 1844.

Sir: I have the honor to transmit, herewith, a report of the Fifth Auditor of the Treasury, in relation to the condition of the light-houses, and the operations generally of the Light-house Establishment, with which that officer is charged under the direction of this Department. To his communication are appended the reports of the different superintendents of light-houses.

These documents will furnish very full information of the condition of the light-houses, and will enable Congress to determine on the suggestions respecting the abandonment of some of them, and the establishment of others.

I also communicate a separate report, by Mr. D. Wilson, superintendent of light-houses on the northwestern lakes, as containing important suggestions, which can be carried into effect only by legislative authority.

I have the honor to be, sir, very respectfully, your obedient servant,

J. C. SPENCER,
Secretary of the Treasury.

Hon. J. W. Jones,
Speaker of the House of Representatives
Treasury Department,  
Fifth Auditor’s Office, October 30, 1843.

Sir: I have the honor to acknowledge the receipt of your letter of the 17th instant, desiring to be furnished with a general statement of the condition of the light-houses; what has been done during the past year; the lights that ought to be abandoned, or their positions changed, and the additional lights which appear to be necessary; and such other general information on the subject as I may deem necessary.

The most authentic information in relation to the condition of the buildings, the lighting apparatus, and the efficiency of the lights in my possession, is contained in the reports made during the past summer by the several superintendents,* who are all intelligent and respectable men, and who visited in person and inspected all the light-houses in their respective districts. These reports I have caused to be copied and enclosed, as the answer to this branch of the inquiry. The reports show all the light-houses and apparatus which required repair, and generally an estimate of the expense of making the repairs—all of which have been made for about the sums estimated; a list of which was transmitted to you on the 14th of September ult. It is gratifying to perceive, in these reports, the general good condition of the establishment, and particularly of the lighting apparatus; the greater part of which on the seaboard is composed of the improved reflectors made in moulds, or dies, and of the size of 21 inches diameter. Where new lanterns have been required, they have also been greatly improved, by introducing large panes of plate glass, from 24 by 18 inches to 50 by 30 inches, in place of those formerly used with common glass, 12 by 10 inches, and thus dispensing with a large quantity of iron sash, which obstructed the light. As the old apparatus and lanterns yet remaining in many of the light-houses become unfit for use, it is my purpose to replace them with the improved apparatus and lanterns. It is no less gratifying to perceive that the keepers generally are deserving of the highest praise for the cleanliness observed in their premises, the care taken of the lamps and reflectors, and the fidelity with which they discharge their respective trusts.

As to lights which ought to be discontinued, and to others which, ought to be established:

According to the best information I possess upon the subject, I should recommend the discontinuance of four light-houses only, viz:—
Mayo’s beach, Wellfleet, Massachusetts.
Port Clinton, Lake Erie, Ohio.
Smith’s Point, near the mouth of Potomac, Virginia.
St. Joseph’s, entrance of St. Joseph’s bay, Florida.

In regard to the first, the collectors, and many other persons who have examined it, have reported to me that it was useful to a few fishermen only, who could very well enter the port without it, and that it was considered a useless expense. In consequence of this information, I directed that the number of lamps be reduced to three, which is the number now in use. It may and ought to be dispensed with, however.

*Except the one at New Orleans, who has made no report.
As to Port Clinton light, it is reported that not more than one or two vessels enter the port in the course of a year. It can very well be discontinued, and the building and land on which it stands be sold.

Off Smith's point we are obliged to keep a floating light at great expense, to guard vessels from a dangerous shoal that makes out from the point, for which the light-house was found to be inadequate. Hence the light-house has become of little or no use.

The town of St. Joseph having been abandoned some time ago, (for the use of which the light-house at the entrance of St. Joseph's bay was established,) the collector at Apalachicola reported that the light ought to be discontinued, it being now a useless expense. This information has already been communicated to the Committee on Commerce of the House of Representatives, for the action of Congress; no authority being possessed by the Executive for the discontinuance of a light.

As to lights which ought to be established:

It is my practice, at the commencement of every regular session of Congress, to lay before the Committees on Commerce of both Houses, a statement of what has been done in relation to this branch of service the preceding year, and what is necessary for Congress to authorize to be done for the future. Such information has been given to these committees, from time to time, since the year 1839; and bills have been reported by one or the other of the committees, at each regular session subsequently; but none of those bills have become laws. My letter to the Committee on Commerce of 13th December, 1842, the commencement of the last session, (of which a copy is enclosed,) together with the bills reported by Mr. Clark, (Nos. 475 and 432,) and those reported afterwards by Mr. Winthrop, (Nos 800 and 801,) contain information of what was then contemplated for the light-house service. A few additional objects will be presented to the committees when Congress shall be in session, for the necessary appropriations; the principal of which will be the rebuilding of the light-house on Matinicus rock, in Maine, at a cost of $11,000, which was found to be too large a sum to be drawn from the annual appropriation for repairs.

The bill 432, before referred to, is a very important one, as, if passed into a law, it would enable me to employ two vessels on the Atlantic coast instead of one, with two intelligent and capable men to deliver the oil and other articles necessary for lighting the lamps, and making the necessary examinations and reports to this office. This duty is now too much for one person and one vessel. Captain Howland, who is now employed with his vessel to deliver the oil and other things, and to report the condition of the lights, is engaged the whole year on this duty; and even so has not time to repair the lamps, adjust the reflectors, and make the examination of the buildings, in as careful and satisfactory a manner as it ought to be done. Were there two vessels and inspectors—one to proceed from the Chesapeake south, and the other north—there would be time to deliver everything for lighting, convey men and materials for making necessary repairs, visit the light-houses twice or thrice during the year, and make reports of their condition to the general superintendent. The collectors would thus be relieved from making personal examinations of the lights in their districts, and, with the occa-
sional aid of inspectors of the customs, (some of whom can always be spared,) the light-houses, beacons, buoys, and floating lights can everywhere be kept in proper order.

On investigating the subject of a small lamp used by the keeper of Straitsmouth light-house, for keeping the oil fluid in winter, concerning which he wrote to you in the early part of the past summer, (whose letter you referred to m-.) and which he claimed as his invention, and as a great improvement, I find it is nothing more than a common house lamp, which he calls a nurse lamp, placed under each of the fountains of the light-house lamps, the flame from which, as every person must know, would keep the oil in the large lamps in a fluid state. The result has been an additional consumption of oil of from 10 to 12 gallons a year for each lamp. The same contrivance has been used at Thatcher’s island light-houses, where there are 22 lamps, and, consequently, the increased consumption and waste has been, in the two light-houses, at the lowest rate, about 280 gallons of oil per annum. The increased consumption has been ascertained from the reports of Captain Howland, of the supply vessel, who states the consumption at Straitsmouth for the last year to have been 45½ gallons per lamp, and that at Thatcher’s island at 44 gallons per lamp, whilst the average of all the other light-houses does not exceed 33 gallons.

As the oil-heater, an American invention, is, and has been for many years, applied to all the light-houses north of Georgia, and, if properly adjusted over the tube-glasses, will keep the oil in the fountains in a fluid state in the coldest weather, there is no possible advantage in using the small lamp before referred to, and the consumption of oil occasioned by it is without any useful object. I have instructed Mr. Rantoul, the superintendent at Boston, to forbid the further use of these lamps, and to restore and have properly adjusted the oil-heaters in common use.

Having explained so fully and so recently, on calls made by the Committee on Commerce of the House of Representatives, the plans and cost of our buildings; the cost of maintaining the lights annually; the manner of fitting them up, and supplying them with oil and other articles necessary to keep them lit; the efficiency of the lights; the economy used in building and maintaining them, as compared with the lights of England, Scotland, and France, I refrain from adding any further remarks under these particular heads—particularly as the letters and statements embracing them have been printed with the report of the Committee on Commerce. under date of 25th May, 1842, 2d session 27th Congress, and which is numbered 811.

Having, in a preceding part of this report, referred to the reports of the superintendents, who examined all the lights, during the past summer, for the general good condition of the establishment, it may be proper to enter somewhat more into detail in relation particularly to the light-houses in Maine, New Hampshire, and Massachusetts, concerning which complaints and misrepresentations have been made and extensively circulated, altogether by persons who had no interest whatever in commerce or navigation; none of them owning or commanding a ship, or exporting or importing merchandise of any kind.

The buildings, which have all been made of split stones, or hard bricks,
have been represented as being in a very dilapidated state—the mortar having fallen from the joints, for want of a due proportion of lime in it. It has been shown, by a report made to Congress, and printed with House Document No. 282, 3d session 27th Congress, that a due proportion of lime had always been used in erecting the buildings, and that although, by the action of the salt water and salt air upon the mortar, it decomposed and fell from the joints, yet the walls themselves stood firm, and, being pointed with hydraulic cement, were rendered substantial and dry.

* * * * * * *

The lighting apparatus, in these several districts, has also been represented to be improperly adjusted, in bad order, and the reflectors made upon the wash-basin principle. It has also been stated that the lights could be seen but an inconsiderable distance—some of them not more than five or six miles. There is no part of this statement well founded, as will be seen by the reports of the superintendents, corroborated by statements from the captains of cutters.

Some of the apparatus in Maine is old and much worn, but it still affords a good light, and is replaced so soon as it fails to give a good light. The superintendents report it generally to be efficient, in good order, and well attended to by the keepers. The distance the lights can be seen will, of itself, disprove any assertion of the kind just alluded to.

As to the reflectors being made on the wash-basin principle, or in the form of a wash-basin, nothing can be further from the truth. That they are as near a parabola as can be made, it is only necessary to refer to the report of the Committee on Commerce, before referred to, to be satisfied of the fact.

Being in the habit of corresponding with Mr. Fresnel, the able and scientific engineer and superintendent of the French light-houses, I transmitted to him, some time ago, a copy of the above report, and have lately received a long and interesting letter from him, dated 25th August last, in relation to it; and, from this letter, in justice to the establishment, I beg leave to furnish you with an extract, as follows:

"One often proceeds by averages in grouping light-houses and beacons of every order; and I commence by acknowledging that this mode of comparison, in spite of the objections it may furnish, shows, in an incontestable manner, this fact, that the apparatus with parabolic reverberating reflectors are nowhere used with less expense for maritime lighting than in your country.

"It gives me cordial satisfaction to add, (if I can, with propriety, interfere in a foreign dispute,) that you have victoriously repelled the attacks directed against the administration of the light-houses of the United States, and that their administration has acquired the best right to the gratitude of all maritime nations for the immense services which it has afforded to navigation for so many years."

I have the honor to be, sir, very respectfully, your obedient servant,

S. PLEASONTON.

Hon. John C. Spencer,
Secretary of the Treasury.
LIGH-T- HOUSE PAPERS.

LIGHT-HOUSES.

Letter from the Secretary of the Treasury, transmitting Fifth Auditor's report relative to light-houses and lights.

JANUARY 19, 1844.—Read, and referred to the Committee on Commerce.

TREASURY DEPARTMENT, January 18, 1844.

Sir: I have the honor to transmit herewith a report from the Fifth Auditor, who has charge of the Light-house Establishment, accompanied by information respecting the efficiency of the lights, and a list of the lights in the United States, in Great Britain, and in France.

I am, very respectfully, sir, your obedient servant,

J. C. SPENCER,
Secretary of the Treasury.

Hon. J. W. Jones,
Speaker of the House of Representatives.

TREASURY DEPARTMENT,
Fifth Auditor's Office, January 3, 1844.

Sir: The Light-house Establishment within the States of Maine, New Hampshire, and Massachusetts, and its management, having been grossly misrepresented by a man (L. W. P. Lewis) employed by your immediate predecessor to inspect the same, and these calumnies having been communicated to the House of Representatives of the United States, on the 24th of February, 1843, in a document printed and numbered 183, I took occasion in April last to instruct the several superintendents, not only in these States, but in all the States bordering upon the Atlantic, to open books at their respective custom-houses, and to ask the masters of ships and other vessels, as they visited the custom-houses to make entry, to enter in those books their several opinions as to the quality of all the lights from Maine to Louisiana, and to forward these books to me prior to the meeting of Congress at its present session. Having received these books and opinions, (with the exception of one expected from New Orleans, embracing the names of nearly 1,000 masters of ships and other vessels, I have caused two copies to be made of them, one for each House of Congress, and have to ask the favor of you to transmit them accordingly. To the very favorable testimony to the excellence of the lights thus presented, I have added that of the owners of upwards of 1,400 ships and other vessels at Portland, Maine, and resolutions of the Marine Society of that city, highly creditable to the management of the lights, and satisfactory as to their efficiency.

As these lights were established for the benefit of commerce, and the preservation of the lives of those engaged in it, the testimony of owners and captains of ships, it will be admitted, is of the highest order, and must be conclusive as to the quality of the lights on our coast.

In the report before alluded to is an affidavit by one Daniel Bryant, (page 30,) procured with a view of impeaching my character, in connec-
tion with Mr. Winslow Lewis, who was employed by Mr. Bancroft to build three small light-houses at Nauset beach. Unfortunately for David Bryant, there is not one word of truth in his deposition in regard to myself. The history of the case, to which he refers, is as follows:

Having three small light-houses to erect on Nauset beach, in 1838, agreeably to law, Mr. Bancroft, the collector at Boston, was directed by me to advertise for proposals to erect the buildings by contract, and give the work to the lowest bidder, and to appoint a suitable mechanic to oversee the work, and make payment on his certificate that it was well done.

Winslow Lewis was the lowest bidder; the contract was given to him, and David Bryant was appointed by Mr. Bancroft to oversee the work. In due time, (viz: on the 80th of July, 1838,) Mr. Bancroft wrote to me that the work was done, and done in a manner to do credit to Mr. Lewis, and was the best work of the kind, probably, in his district. On the same day David Bryant certified that the contract had been fully complied with, and Mr. Lewis was paid his money. Copies of three letters from Mr. Bancroft, on this subject, in relation to this matter, marked A, B, and C, are herewith enclosed.

By referring to David Bryant's affidavit, given on the 2d of December, 1842, more than four years afterwards, it will be seen that he states as follows:

"When the job was finished, I was called upon by the contractor to sign a certificate that the terms of his contract or agreement had been honorably fulfilled. This paper I refused to sign, and referred the contractor to the collector at Boston, to whom I made a formal statement of the facts upon my return to Boston from Cape Cod. After a delay of some time, I received notice to call upon the collector at the custom-house, and when I called there, I was directed to sign the certificate of approval before named. Upon inquiry why I should sign it when its contents were untrue, I was told that the Fifth Auditor had accepted the work upon the representations made to him by the contractor, and had ordered the contractor to be paid, and that I must sign the document as a matter of form; and I, therefore, did sign the same. I considered my objections waived by the Government."

Now, I aver that I never received a letter from Winslow Lewis, the contractor, upon this subject, and never wrote a line to Mr. Bancroft. Indeed, the letter of Mr. Bancroft to me, of the 80th July, 1838, and the one received from him under date of 17th December last, fully prove this fact. This man, Bryant, will be indicted, and probably punished, for perjury in this case.

Permit me, respectfully, to request that these papers may be laid before Congress, distinct from any other communication you may think proper to make in relation to our Light-house Establishment.

I have the honor to be, sir, respectfully, your obedient servant,

S PLEASONTON.

Hon. John C. Spencer,
Secretary of the Treasury.
Report of the Secretary of the Treasury, communicating (in compliance with a resolution of the Senate) the result of an experiment to ascertain the expediency of using gas, instead of oil, in the Light-house Establishment.

MAY 24, 1844.—Read, and referred to the Committee on Commerce. MAY 28, 1844.—Discharged. MARCH 3, 1845.—Ordered to be printed.

TREASURY DEPARTMENT, May 23, 1844.

SIR: In obedience to a resolution of the Senate, dated the 18th instant, instructing the Secretary of the Treasury to communicate “the result of an experiment made at the Christiana light-house, for the purpose of ascertaining the expediency of using gas, instead of oil, in the Light-house Establishment, stating the relative cost of the same, and the opinion of the Department on the subject,” I have the honor to transmit copies of letters from B. F. Coston and Captain Henry Prince, jr., showing the results of the experiments referred to in the resolution.

A copy of a letter from S. Pleasonton, Esq., together with copies of certain papers therewith transmitted, showing the measures taken more fully to ascertain, by further trial, the relative cost of gas as compared with oil, and the opinions of experienced men on that and other points connected with the general use of gas as a substitute for oil, are also enclosed.

The conflicting views presented in the papers thus enclosed suggest caution in the expression of any definite opinion. Thus far, the experiment has certainly been encouraging; but until the results of the further use of gas, in the experiments now in progress, are known, the Department can form no satisfactory conclusion.

I have the honor to be, very respectfully, sir, your obedient servant,

McCLINTOCK YOUNG,
Secretary of the Treasury, ad interim.

Hon. W. P. MANGUM,
President of the Senate.

WILMINGTON, May 16, 1844.

SIR: In compliance with the instructions of the Secretary of the Treasury, contained in his letter of the 10th of November, 1843, in reference to the light-house at Christiana creek, I have the honor to inform you that I have completed the work, and to my entire satisfaction. The light-house is now lighted by gas, and is in successful operation.

I beg leave to refer you to the report of Captain H. Prince of the revenue marine, a copy of which is hereto annexed, in furtherance of the orders of the Treasury Department of the 25th of April last, where, somewhat in detail, the principles of my experiment and the extent of my success are explained.

The result of this experiment has enabled me to establish the following comparison:

The most accurate computation of the cost of lighting the light-houses
with oil, agreeably to the plan now in general use, is at an average of one dollar per night for every ten lamps.

The cost of gas light, agreeably to my plan, is twenty cents per night, and the amount of light given is three times as great as from oil, each gas burner being equal to three of the best light-house lamps.

I beg leave here to remark, that this practical test of my theory of lighting light-houses has more than confirmed all my anticipations, and has met with the undivided approval of all who have seen and examined this light. The want of elevation in the Christiana light-house, being only 47 feet from the surface of the water to the light, and the insular locality of the site, not having in any one direction a sufficient continuous range of vision to show the light to the fullest extent of its beneficial results, deprive this experiment of some of its advantages.

To give to this experiment a more enlarged and thorough test, I should be particularly gratified to have the experiment tried upon the unoccupied tower on the Highland of Navesink, where a comparison could be made with the French lenses now used there and the gas light upon my plan of construction. This could be done at a cost to the Government of about one thousand dollars; and, from the advantages of the great elevation of the light, the uninterrupted range out at sea to an indefinite extent, and on that great commercial highway, a full, thorough, and unembarrassed test could be made, that would involve the relative cost of construction, quality, quantity, and expense of the light, and everything necessary to institute a comparison of the present system of lighting light-houses with the plan that I propose.

I therefore most respectfully ask to be employed in carrying out this experiment.

Most respectfully, your obedient servant,

BENJAMIN F. COSTON.

McClintock Young, Esq.,
Secretary, ad interim.

CHRISTIANA CREEK LIGHT-HOUSE, May 1, 1844.

In obedience to the order of the Hon. John C. Spencer, Secretary of the Treasury, the subjoined report of the examination of the light-house on Christiana creek, Delaware, under the superintendence of the Hon. Arnold Naudain, collector for the port and district of Wilmington, is respectfully submitted for the consideration of the Department:

REPORT.

OF THE LANTERN AND APPARATUS.

Height of the lantern above the surface of the river, forty-seven feet; diameter of the lantern, six feet; height from the deck, six feet; form, octagon, with fifteen panes of glass on each side. It contains ten gas burners and ten reflectors of fifteen inches in diameter, and ten feet of half-inch iron pipe, for the arms of the burners.
APPARATUS OF THE GAS-WORK.

Diameter of the gasometer, ten feet; depth of the gasometer, ten feet—of iron, weighing fourteen hundred and fifty pounds, and contains seven hundred and fifty cubic feet of gas. The cistern, of wood, ten feet and six inches in diameter, and eleven feet in height. The retort is three feet six inches long, one foot six inches wide, and eight inches deep—and will probably require an annual renewal. The furnace is four feet high and four feet long. The rosin kettle is eighteen inches deep and sixteen inches in diameter. The condenser, of iron, four feet long, one foot high, and one foot wide. Six wrought-iron pipes, three inches in diameter, and ten feet high. Sixteen feet of three-inch pipe, conducting to the gasometer. Sixty-six feet of one-inch pipe, conducting to the lantern. Twenty-seven feet of half-inch pipe, conducting to the rooms of the dwelling. Four pulleys, with thirty feet of chain attached to fifteen hundred pounds weight, to suspend the gasometer. The tar pump, of iron. The tar cistern, of brick, three feet long, two feet wide, and three feet deep. Proof of the pipe, two hundred pounds to the square inch. Pressure of the gas on the pipes, three-quarters of a pound to the square inch.

OF THE DANGER OF USING GAS.

My own opinion of the using of gas is, that it may be attended with some danger from fire in wooden buildings, but no greater than that created by the fires used for warmth or culinary purposes. In buildings constructed with brick, stone, or iron, there cannot exist any danger whatever.

AMOUNT OF GAS CONSUMED.

About one pound of anthracite coal per hour, at a cost of one-fourth of a cent. The same weight of coke per hour, at a cost of one-fifteenth of a cent. About two and a half pounds of rosin per hour, at a cost of two-fifths of a cent.

HENRY PRINCE, Jr.

---

DELAWARE BAY,

On board the revenue marine schooner "Forward,"
John A. Webster, Esq., Commander.

OF THE INTENSITY OF THE LIGHT.

The comparative intensity of light, as ascertained by the pholometer at the light-house, was, by the gas light, seven and one-half inches; by the oil light, four and one-half inches; or the same degree of light was produced by the gas light at a distance of seven and one-half inches, as by the oil lamp at four and one-half inches.

May 2, at 7½ p. m.—Christiana Creek light, bearing north by east, half east, about eleven miles distance. Reedy Island light, bearing
south, half east, about five miles distance. Christiana light of much greater power than Reedy Island light. Wind south, rainy weather. At 2½ a.m., the light at Christiana, of twice the intensity as Reedy Island light. Moonlight; dark horizon. May 3, at 8 p.m.—Chester, northwest, 150 fathoms. Christiana light very brilliant; estimated distance, twelve miles. May 4, at 3 a.m., bright moonlight; the light very brilliant.

May 4, at 6 minutes past 9 p.m.—The Lazaretto, east by north, half north, two miles; estimated distance from Christiana, fourteen miles; the light brilliant; wind southerly; clear weather. At 3 a.m., the light visible; wind southerly; hazy weather.

Not being in possession of an accurate chart of the Delaware bay, the distances from the several positions of the "Forward," from near Reedy island, Chester, and the Lazaretto, are estimated, and agree with the opinion of the pilots and others navigating the bay.

<table>
<thead>
<tr>
<th>Statute miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea, the radius of vision for forty-seven feet (the height of the lantern on Christiana creek above the surface of the river)</td>
</tr>
<tr>
<td>Height of the eyes of the observer, from the deck of the &quot;Forward,&quot; above the surface of the river, 9 feet, or......</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

The increased distance of two miles, at which the light was visible from the deck of the "Forward," near the Lazaretto, was probably produced by the action of refraction.

From the intervention of the points of land between the "Forward" and the light, longer distances up or down the bay were not available.

The department will be pleased to allow me to express my obligation to Captain Webster of the "Forward," and to Mr. Benjamin F. Coston, for their kind assistance in the aforementioned examination.

Sir, I am, with great respect, your obedient servant,

HENRY PRINCE, JR.,
Captain Revenue Marine.

Hon. JOHN C. SPENCER,
Secretary of the Treasury.

BALTIMORE, May 9, 1844.

---

TREASURY DEPARTMENT,
Fifth Auditor's Office, May 22, 1844.

SIR: I had the honor this morning to receive your note of yesterday's date, enclosing a copy of a resolution of the Senate of the 18th instant, calling upon the Secretary of the Treasury for information as to the result of an experiment made at the Christiana light-house, for the purpose of ascertaining the expediency of using gas instead of oil.
in the Light-house Establishment, and the relative cost of the same, with
the opinion of the Department upon the subject.

The gas light at the Christiana light-house has been so recently put
into operation, (only on the 11th of last month,) that sufficient time has
not been allowed to test its economy as compared with oil light, or the
expediency of its adoption in that or other light-houses; and conse-
quently, the superintendent, Mr. Naudain, has made to me no report of
the expense of generating the gas, though he has reported the light to have
been greatly increased in brilliancy and power. Nor does Captain
Prince state, in the report from him now in my possession, and of which
I herewith transmit a copy, the cost of the gas in a satisfactory man-
ner. I have instructed Mr. Naudain to cause an accurate account of
the expense of the necessary quantity of gas for supplying the light to
be kept continuously throughout the year, to be reported to this office
monthly, in which will be comprehended the short and long nights, as
well as the various seasons which may have an influence on the con-
sumption. We shall thus be enabled, not only to ascertain the expense
of the gas, as compared with that of oil, but whether the apparatus can
be managed by one keeper, and it be sufficiently durable and safe to
recommend it to general use.

We should adopt this change in our light-houses with extreme cau-
tion, and not until full and ample experiments shall have shown its
safety and utility; for wherever it has been tried in Europe for light-
house purposes, it has been condemned. For the propriety of this
course, it may be useful to refer to the testimony of Robert Stevenson,
Esq., and Mr. McConnican, contained in a report upon light-houses,
made by the House of Commons, in England, in 1834, herewith en-
closed; and to two letters from Mr. Mowton, secretary of the gas com-
pany in Baltimore, of the 23d and 28th of November last, in answer to
inquiries from this office, of which copies are enclosed, and in which
the opinions of that company adverse to the employment of this light
are fully expressed.

I have the honor to be, respectfully, sir, your obedient servant.

S. PLEASONTON.

McCLINTOCK YOUNG, Esq.,
Secretary of the Treasury, ad interim.

---

Extracts from "Minutes of Evidence taken before the Committee of the
House of Commons on Light-houses, April, 1834.

Quest. 2181. What is the result at the present moment of all your
observations as to the most economical and best light that can be used?
Consider them well.

Ans. In the present state of my information, the result that I have
come to is, that the simple Argand burner and reflector, as now used, is,
on the whole, the most economical and the most manageable of any of
the other systems of lighting with oil. The gas, I think, a very uncer-
tain mode of lighting an establishment of that kind. When I visited Holyhead in October last, I found the gas-house partly unroofed; they had an explosion just a day or two before I arrived, and that had been the third accident they had had; one man had been killed, others narrowly escaped. It would, therefore, require to be introduced with great caution upon the coast. There may be preventive means, but there is certainly, under all circumstances, great danger.

Quest. 2132. The danger to which you allude would be lessened, were the reservoirs at a distance from the light-house, and not likely to affect it in case of explosion?

Ans. It would; but it would be necessary to increase the number of light-keepers. Accidents of that kind might kill the keepers, were they near the apparatus.

Quest. 2133. Is oil gas attended with that danger?

Ans. It is oil gas that is in use in Holyhead, and which I am speaking of.

Quest. 2134. Do you know the immediate cause of the explosion that took place at Holyhead?

Ans. The explosion that happened in October last, before I reached Holyhead, was owing to one of the gasometers being somewhat leaky; it was emptied of the gas for repair; but it had not been sufficiently emptied, because, on approaching it with a candle, to examine it, it exploded.

Quest. 3127. You are not aware whether any other experiments have been made on any new lights?

Ans. The substitution of gas instead of oil was suggested to us by Sir David Brewster, and we sent our engineer to Holyhead, where it is now employed; but we found that some accidents had taken place, and that an explosion had very recently occurred, by which the roof of the gas-house had been blown off, and a man killed. We thought that the substitution of gas might probably have led to a reduction of expense; but finding that so serious an accident had taken place, we were very much discouraged from employing it.

CUSTOM-HOUSE, BALTIMORE, November 23, 1843.

SIR: Referring to my letter of the 21st instant, I have now the honor to enclose you a letter addressed to me by Mr. James Mowton, secretary of the gas-light company of this city. Mr. Mowton is well acquainted with the subject on which he writes, and the information which he imparts may be regarded as entirely accurate.

Very respectfully, I am your obedient servant,

N. F. WILLIAMS,
Superintendent of Lights.

S. PLEASONTON, Esq.,
Fifth Auditor, Washington.
OFFICE OF THE GAS-LIGHT COMPANY OF BALTIMORE,
Baltimore, November 22, 1843.

Sir: I do not perceive that I can, from the data you have furnished me, ascertain "what would be the cost of gas made from coal, and the cost of it made from rosin, for fifteen lamps or jets an entire year," inasmuch as the size of the lamps or jets is not given; and the size, it is manifest, must form an essential element in the calculation.

But I presume that the object of the Fifth Auditor, in making the inquiries contained in his letter to you of the 18th instant, will be fully accomplished by stating that 200 cubic feet of coal gas, specific gravity 400, yields as much light as a gallon of best sperm oil, and would cost forty cents. That 130 cubic feet of rosin gas, specific gravity 650, is also equal to one gallon best sperm oil, and would cost 52 cents. The cost of manufacturing the respective gases is given from the experience of the New York Gas Company, which makes rosin gas, and of our company, where coal gas is made. It would certainly not cost less to make these gases on a small scale, and might probably cost more.

As to the dangers of explosion:

Gas itself cannot explode. It is well known that the combination of certain proportions of gas and of atmospheric air forms the explosive mixture. This combination cannot take place, unless the gas be permitted to escape without combustion for a considerable time; a circumstance which could not well occur without the most culpable negligence on the part of the superintendent.

Very respectfully,
JAMES MOWTON, Secretary.

NATHANIEL F. WILLIAMS, Esq.

CUSTOM-HOUSE, BALTIMORE, November 28, 1843.

Sir: I had the honor to receive, yesterday, your letter dated the 25th instant, which I lost no time in handing to Mr. James Mowton. From that gentleman I have this morning received the enclosed answer, which I believe will be found satisfactory, to all the questions propounded to him.

N. F. WILLIAMS,
Superintendent of Lights.

S. PLEASONTON, Esq.,
Fifth Auditor, Washington.

OFFICE OF THE GAS-LIGHT COMPANY OF BALTIMORE,
Baltimore, November 27, 1843.

Sir: I am favored with yours of this date, enclosing a letter from the Fifth Auditor to you of the 25th instant, and requesting me to give you "my opinion on the several questions asked in that letter."
The first question asked is, "would not the cost of producing either
of those gases [resin or coal] be increased considerably by causing them to be made at the light-houses in small quantities?"

My opinion is, that the cost of making gas would be somewhat greater in small quantities than in large. Probably 25 or 30 per cent. would cover the difference.

The second question propounded to me is, "would ignorant men, such as we generally employ as keepers, be competent to make the gas safely and properly, at each light-house?"

To this I reply, that men ignorant of gas-making could not be safely trusted to manage the apparatus proper for generating, purifying, and distributing gas. Persons who are intended for that employment would require considerable preparatory training.

If the light for light-houses be supplied from gas, it will follow as a necessary consequence that light-house keepers will have to be appointed from among those who have acquired a knowledge of the mode of generating gas by working at factories; or else there will have to be a man employed, other than the keeper, at each light-house, possessed of the requisite knowledge and experience; otherwise, the process could not be safely and properly carried on.

When the gas is made and conveyed to the burners, no accident could take place, unless it be suffered to escape without combustion; a circumstance not at all likely to occur, unless from flagrant neglect. But Mr. Pleasonton will not fail to perceive that this opinion as to the safety of using gas, after it is made, does not at all conflict with the opinion that the apparatus for generating and purifying gas could not be safely intrusted to a man without experience in the use of that apparatus.

My opinion is also required as to whether it [gas] would answer for our light-houses generally.

I have not the least hesitation in saying that, in my opinion, gas is not a suitable article to use for the illumination of light-houses; and whatever degree of success might attend the experiment in cases peculiarly favorable, yet the general result would be utter failure.

I am, very respectfully, your obedient servant,

JAMES MOWTON.

Nathaniel F. Williams, Esq.,
Collector, &c.

TREASURY DEPARTMENT, May 25, 1844.

Sir: In further answer to a resolution of the Senate, dated the 18th instant, having reference to the comparative cost and advantages of gas as a substitute for oil in the Light-house Establishment, I have the honor to transmit a letter from the Fifth Auditor, with the accompanying papers, which were received this morning.

I am, very respectfully, sir, your obedient servant,

McClintock Young,
Secretary of the Treasury, ad interim.

Hon. W. P. Mangum,
President of the Senate.
Treasury Department,
Fifth Auditor's Office, May 25, 1844.

Sir: I received this morning a letter from Mr. Naudain, the superintendent of the light-house at the mouth of the Christiana river, in Delaware, in relation to the gas light lately put into operation in that light-house, of which I herewith enclose a copy, and beg the favor of you to transmit it to the Senate, as connected with the inquiry contained in their resolution of the 18th instant.

I have the honor to be, sir, very respectfully, your obedient servant,

S. Pleasonton.

McClintock Young, Esq.,
Secretary of the Treasury, ad interim.

Superintendent's Office,
Wilmington, Delaware, May 23, 1844.

Sir: Your letter, dated the 20th instant, requesting the amount of expenditure incurred in fitting up the Christiana light-house for making and burning gas instead of oil, and also "in regard to the expense of conducting this light, in comparison with that attending the oil light, as used in the Argand lamp," has been received.

The first branch of information sought I am now unable to furnish; the bills of expenditure have not yet been furnished to me. I understand they are at this time in Washington, under the inspection of the Secretary of the Treasury.

In accordance with your instructions to that effect, I issued instructions to the keeper of Christiana light to keep an exact account of all the materials used in the manufacture of gas, and to make a monthly return. He began to keep this account on the first day of May. I have now the honor to transmit you his account for 22 days of this month, which is all that can yet be furnished. The aggregate value of materials consumed for gas to burn 10 lights for 22 nights is $3 58, being nearly 16½ cents per night for 10 lights, or rather more than 1½ cent each light per night. In this district we have five 10-light light-houses, viz: Bombay Hook, Mahon's, beacon at Cape Henlopen, Egg Island, and Cohanseay. The average consumption of these lights for the second quarter of 1842-'3 was 3 quarts each night; this, for 22 nights, would be 16½ gallons, and at 90 cents, the present price of oil, would amount to $14 85, or 67¼ cents per night.

But the intensity of the light from gas is so great that as good a light, perhaps better, would be furnished by one-half the number of burners that are used with oil. This would make the comparative expense for the same amount of light furnished by gas only one-half of the above statement.

This statement, although the result of a very brief experiment, is believed to embrace all the materials actually consumed in the manufac-
ture of the gas consumed in 22 nights at the Christiana light-house, and the comparison fairly made with the other 10-light light-houses in this district.

I have the honor to be, most respectfully, your obedient servant,

ARNOLD NAUDAIN,
Superintendent.

STEPHEN PLEASONTON, Esq.,
Fifth Auditor, &c.

CHRISTIANA LIGHT-HOUSE, May 22, 1844.

Amount of materials used at the Christiana light-house from May 1 to May 22, 1844.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 barrels of rosin, 90 cents per barrel</td>
<td></td>
<td>$1.80</td>
</tr>
<tr>
<td>2½ bushels coal, 16 cents per bushel</td>
<td></td>
<td>4.00</td>
</tr>
<tr>
<td>14½ bushels coke, 6½ cents per bushel</td>
<td></td>
<td>9.10</td>
</tr>
<tr>
<td>½ bushel clay, 50 cents per bushel</td>
<td></td>
<td>2.50</td>
</tr>
<tr>
<td>1 yard muslin, 10 cents per yard</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>1¼ pound soap, at 8 cents per pound</td>
<td></td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.58</td>
</tr>
</tbody>
</table>

BENJAMIN A. CROZIER, Keeper.

TREASURY DEPARTMENT, February 18, 1845.

SIR: In further answer to the resolution of the Senate, dated 18th April last, on the subject of the experiment made at the light-house at Christiana river, for the purpose of testing the advantages of gas as a substitute for oil in the light-houses, I have the honor to enclose herewith——

1st. Letter from S. Pleasonton, Esq., Fifth Auditor, &c., dated December 30, 1844, accompanied by the report of a commission appointed to investigate the subject.

2d. Reply to the report of the commissioners, by Benjamin F. Coston.

3d. Report on the same subject, from A. Naudain, Esq., collector and superintendent of the lights in the district of Delaware.

With the view of further testing the advantages resulting from the substitution of gas, the Department has authorized the light-houses at Egg island, Reedy island, and Cohanseey creek, to be provided with the necessary fixtures and apparatus for the use of gas.

I am, very respectfully, sir, your obedient servant,

GEORGE M. BIBB,
Secretary of the Treasury.

Hon. W. P. MANGUM,
President of the Senate.
Treasury Department,
Fifth Auditor's Office, December 30, 1844.

Sir: On the 22d May last, I addressed a letter to the acting Secretary of the Treasury, in pursuance of a resolution of the Senate of the 18th of that month, calling for the result of an experiment made at the Christiana light-house, for the purpose of ascertaining the expediency of using gas instead of oil in the Light-house Establishment, in which it was stated that sufficient time had not then elapsed to afford the information required.

Keeping in view the object of the resolution, I recently instructed the superintendent at Wilmington, Delaware, to ask the favor of three scientific and disinterested gentlemen to repair to the light-house, and to report their opinion as to the fitness of gas for light-houses, its advantages and disadvantages, and its cost in relation to other kinds of light, and particularly whether, from the explosive nature of gas, it would be advisable to adopt that mode of lighting our light-houses. They were also requested to state whether the mode of producing gas at the Christiana light-house was an improvement, and, if so, in what it consisted.

The superintendent accordingly invited three gentlemen, all distinguished for scientific knowledge, and some of them practically acquainted with the production and all the properties of gas made from different materials, viz: Messrs. Walter R. Johnson, John C. Cresson, and George W. Smith, to undertake this duty; which they obligingly did, without compensation. Having repaired to the light-house, and made the necessary examination, they transmitted to this office, through the superintendent, the full, able, and interesting report, of which I have now the honor to enclose a copy, with the request that you will transmit the same to the honorable Senate of the United States.

Mr. Johnson, being in this city subsequently to the date of the report, and being furnished by me with a report made by a committee of the House of Commons upon the Bude light introduced into their chamber by Mr. Gurney, has addressed to me an interesting letter founded upon that report, and as connected with the inquiry relative to the gas light at Christiana. A copy of that letter, dated 24th December, is annexed to the principal report.

I have the honor to be, respectfully, sir, your obedient servant,

S. Pleasonton.

Hon. George M. Bibb,
Secretary of the Treasury.

---

Reply to the report of the committee appointed to examine the gas light at Christiana creek, by Benjamin F. Coston, U. S. N.

In looking over the report of the board, appointed by the Fifth Auditor of the Treasury Department, to examine the gas light at Christiana creek, in the State of Delaware, many important facts have been omitted, and errors of calculation made, which I think ought to be pointed out and corrected, not only that justice may be done to the humble indi-
vidual who claims to be the first to introduce successfully gas for light-
ing light-houses, generated in the building for the express purpose, but
to meet all the objects of the Government in instituting this investi-
gation.

As the originator of this light, I therefore regard it as a duty to reply
to the objectionable portions of their report.

First, in page 15, paragraph 2, in comparing the relative intensity of
the gas and lard lights, the board say they made use of a lard lamp, the
flame of which was three inches high, whilst that of the gas was one and
a half inch.

Now, in order to form a just estimate of the brilliancy of two different
lights, by means of a photometer, they should be both of the same height,
or the comparison cannot be made with accuracy.

Again, (page 20,) in comparing the relative intensity of gas and oil
lights for light-houses, the board placed the two lights four or five feet
distant from the centre of the photometer. The difference in the color
of the two lights (the oil being red and the gas white) renders it impos-
sible to form a comparison at so great a distance. In the repeated trials
made by Captain Prince, Doctor Naudain, (the collector at Wilmington,) and
myself, by means of a photometer constructed according to the
directions of Doctor Ure, the gas light was invariably three times the
intensity of the oil light heretofore used at the light-house. (Vide Cap-
tain Prince's report to the Secretary of the Treasury, on the gas light
at Christiana.)

In the next place, that part of the report which relates to lard as a
means of obtaining light, although the great superiority of gas over oil
is admitted, is calculated to mislead the department into the belief that
lard can be used advantageously in light-houses. I deem it impractica-
ble to burn lard in the focus of our light-house reflectors, in the present
light-house lamps, or any other lamp now known; nor is it at all probable
that a lamp can ever be constructed for the purpose, from the fact that
lard requires a great heat to keep it fluid, which can only be done when
the burner of the lamp is placed in the fountain. Such a lamp could
not be used for light-house purposes. Again, should a lamp to burn lard
for light-houses ever be invented, the obstruction that it would unavoida-
bly interpose to the rays of light emanating from the focus of the para-
bolic reflectors used in light-houses would be more than our present
light-house lamps, which are considered defective in that particular.
To this objection the gas burner, from its diminutive size, is of course
not obnoxious, and, being plated, affords a perfect remedy to that defect
of the present lamps.

Again: The extreme heat of the lard lamp, indispensable to keep the
lard in a fluid state, will, on every occasion that the wicks require trim-
m ing, which occurs not less than three times during the night, render
the necessary handling very difficult, not to say impossible, without the
lapse of sufficient time for it to cool. Nor should it be forgotten, that,
during this manipulation, the light would be materially diminished, and
rendered unsteady, to the great danger of the mariner, who would be
liable to mistake the particular light-house by which he might be direct-
ing his course. It is true that this difficulty exists with the present oil
lamps, though not to the same extent; but it is equally true that gas entirely obviates it.

In the middle and northern latitudes, it is found necessary to use not only a charcoal stove, but also a copper heater connected with the lamp, to keep winter-strained oil in a fluid state. Even with these aids, during the intense cold of three months of the year, it is frequently very difficult to keep the oil in a proper condition for use. From these facts some inference may be drawn of the inapplicability of lard to the purpose.

Again: The character of the flame of a lard lamp is not such as would recommend its use in light-houses, as the flame of lard is from three to four inches high. Of course, only one inch of that flame would be in the focus of the parabolic reflector; the remaining two-thirds would be diffused and measurably lost.

Again: The board is in error with regard to the cost of the gas light. They have based their calculations of the cost of materials upon the result of a single operation, (page 25,) which proved nothing, from the fact that the apparatus which was in proper order to make gas at 10 o’clock was not used until 12, and of course was consuming fuel for two hours to no purpose connected with the experiment. This fact the board have lost sight of, or at least have not stated in their report; but it is nevertheless true, as I was present, and vouch for its verity.

Again: The board state (p. 27) that they used 70 pounds of rosin to generate 486 cubic feet of gas. To be sure, this amount of rosin was placed in the melting kettle during the operation, but it did not come out again; and as the board did not weigh the amount of material that was in the kettle before commencing operations, and as they failed to do so when they ended, they can have no knowledge of the exact amount of rosin used. From repeated experiments of my own, and that of Captain Prince, (vide report,) together with the actual practical results since the apparatus has been in operation, a period of nine months, it has been found that from 75 to 80 pounds of rosin will invariably generate 750 cubic feet of gas. The cost of rosin used at the light-house was 85 cents per barrel, each averaging 300 pounds.

The cost of 78 pounds of rosin would be...................... 22 cents.
The cost of 3 bushels of coke, at 6½........ .................. 18½ "  "

40½ "  "

This shows the consumption of materials for 750 cubic feet of gas. It has been proved by actual practice that 150 cubic feet of this gas will supply 5 of my burners for 12 hours, giving a light equal to 15 oil lamps now used in light-houses; and as 750 feet of gas cost 41 cents, 150 feet, sufficient for one night, would cost 8½ cents—thus showing a mistake in the report of the board of 10 cents per night in the cost of material. The report of the board makes the consumption of material 18.66 cents.
As the cost of rosin now is but 65 cents per barrel, the cost of
78 pounds would be........................................ 17 cts.
Three bushels of coke, at 6½ .................................. 18½ "

Cost of 750 feet of gas, sufficient for five nights...... 35½ "

The cost for one night would be 7½ cents.
The total cost of materials for making gas one year......... $26 64½
Wear and tear of apparatus for one year..................... 23 25

Cost of gas light per annum, (five burners).................. 49 89½

But a more practical and accurate estimate of the cost of the gas light can be derived from the monthly returns of the light-house keeper for the last six months; and by reference to the returns of the keeper of the same light-house for the oil light for the last five years, the relative costs of the two lights can be had.
The average consumption of the present light-house lamps is
1 pint in 12 hours; and as 15 oil lamps are required to give the same amount of light as 5 gas burners, the consumption of oil for one year would be 684 gallons, which, at $1 per gallon, (the average price for the last five years,) would amount to................................. $684 00
To which must be added, for tube-glasses, soap, brooms, whiting, wicks, &c........................................ 25 00
And for repairs of lamps, oil cans, oil houses, &c............. 25 00

Making the total cost of oil light of 15 lamps for one year.... 734 00

The consumption of lard in one of Cornelius's parlor lard lamps, similar to the one used by the board in their examinations, has been found, by repeated trials, to be 27 ounces in 12 hours, giving the same amount of light as one of the light-house burners.
At this rate, 5 lamps would consume, in 12 hours, 8 pounds 7 ounces, being 3,079 pounds 11 ounces per annum; which, at 6 cents per pound, the present price of lard, would be... $184 75
The cost of wicks, tube-glasses, soap; whiting, &c., would be the same as for oil........................................ 25 00
Repairs of the necessary cans, lamps, &c., per annum........ 25 00

The estimate of $23 25 for the wear and tear of the gas apparatus is based upon the experience of nine months at the light-house at Christians; and I have no doubt that, with the present improved apparatus, it will be still less.
### Table of the relative cost of gas, lard, and oil lights.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>5</td>
<td>219</td>
<td>19</td>
<td></td>
<td></td>
<td>$26 64 1/2</td>
<td>$23 25</td>
<td>$49 89 1/2</td>
<td>$684 11 1/2</td>
<td>1</td>
<td>$684 11 1/2</td>
</tr>
<tr>
<td>Lard</td>
<td>5</td>
<td>3,079 1/11</td>
<td></td>
<td>184 75</td>
<td>$25 00</td>
<td>25 00</td>
<td>234 75</td>
<td>54 1/2</td>
<td>499 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>15</td>
<td></td>
<td>64</td>
<td>684 00</td>
<td>25 00</td>
<td>25 00</td>
<td>734 00</td>
<td>15 1/2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The board, in their report, (page 39,) state that it will cost $100 per annum for the repairs of apparatus and building; also, for renewing and setting retorts, $50 per annum; to which they add, $15 for grate bars, &c. To the first charge, of repairs for apparatus and building, I would state that the building itself, to contain the apparatus, will not be subject to any greater expense than an ordinary building for other purposes of the same size, (16 by 16 feet;) and the only part of the apparatus that will require any increase or repair is the retort and fire bricks in the furnace, for which the preceding estimate ($23 25) is amply sufficient.

Another charge that the board makes in their report, (page 39,) is the interest on the first cost of the gas apparatus, (which they estimate at $1,500,) ninety dollars per annum. As they have failed to tax with interest the building of the light-house, salary of keeper, prices of necessary oil or lard, lamps, reflectors, &c., it would be but just to relieve the gas apparatus to the same extent.

The report of the board, in answer to the Fifth Auditor's question respecting the originality of the invention, states (page 49) that there is no novelty in making gas from rosin. To this I would reply, that I never preferred any claim to the discovery of rosin gas.

In the same page, in detailing the various portions of the apparatus, they particularly mention all those portions that bear any resemblance to other gas establishments, whilst those parts that are really original are not so noticed. In speaking of the vertical branch attached to the retort, (page 48,) they say that it has probably the advantage of yielding less tar than would otherwise be obtained. It is proper here to remark, that wherever there is a saving of tar, there is a proportionate increase of gas; and that the great advantage of my apparatus is, that, with a retort 4 feet 6 inches long, it will generate (vide report of board, page 26) 196 cubic feet of gas per hour, making only sufficient tar to return to the kettle to render the rosin fluid. This shows that the whole amount
of rosin is converted into gas—a feature altogether novel, and found in no other rosin-gas establishment. Some advantage must result, most obviously, from the improvements in my apparatus; for, at the Wilmington and other gas works, the time required to generate 196 feet of gas is 2 hours—twice the time required by mine—while their apparatus is nearly twice the size. They also incur a waste of at least 20 per cent. of the rosin employed to make gas, in the shape of refuse tar.

Again, (page 28,) the board state that the illuminating power of the gas had evidently increased, as the light-house burner became heated, and the consumption of the gas was the same as in their former trials, showing the advantage resulting from the use of my burner; while, in their answer as to the originality of the invention, they pass over this manifest improvement without mention.

Again: In their report, (page 49,) in reference to the feeder employed in my apparatus, (which they term a "tar seal,"') they say it keeps the melted rosin very hot, and obviates choking in the supply pipe; beyond this, they say they are not aware of its being superior to the common syphon tube used in other gas works. The great desideratum for a light-house is a sure and safe light, which could not be insured with an apparatus fed by a syphon tube. As the keeper never makes gas until his gasometer is emptied, should the syphon become obstructed, he could not make gas until the obstruction had been removed, which could not be done in time to make gas for that night's supply. It is therefore important that the great and admitted defects in the use of the syphon are thoroughly obviated by my invention of the tar seal.

Again: The board have also failed to state, in their answer as to the originality of this invention, that this Christiana light-house is the first and only light-house ever successfully lighted by means of gas generated in the light-house. It has been heretofore deemed, by some of the most learned and scientific men in Europe and this country, utterly impracticable, particularly in its application to revolving lights. (Report of Alan Stevenson, commissioner of lights of England and Scotland, House of Commons, 1854.)

There are several other improvements, of which the board have made no mention, which are not necessary to enumerate.

In arriving at results in the progress of this investigation, it is important to bear in mind that everything relating to the introduction of gas for light-house purposes has been reduced to the test of practice; embracing its adaptation, its cost, quality, safety, regularity, &c.; whilst lard light, for the same purpose, is entirely hypothetical, and the hypothesis, too, is sustained by calculations that are erroneous, and arguments that are unsound, as I think I have shown in a previous part of this letter.

One important fact is admitted by the board; which is, that the kind of lamp necessary to be used for burning lard for light-house purposes is yet to be invented! This makes a hiatus between their premises and conclusions, that leaves the matter both speculative and problematical. I would further remark, that the experiments of the board were entirely defective in one important point, to wit: they fail to prove anything in relation to the practical adaptation of lard light for light-house purposes.
The difference, therefore, between the relative recommendations of gas and lard, as they now exist, is just the difference between practice and speculation.

For the information of the honorable the Secretary of the Treasury, I would state, that since the erection of the gas apparatus at Christiana, I have made a number of important improvements in the construction of the same. The improved apparatus can be managed (and repaired if necessary) by any man of ordinary capacity, without the assistance of a second person. It also dispenses with the use of a brick furnace, is portable, and requires but half the space necessary for the present apparatus at the light-house. I would also state, that this mode of lighting light-houses is an invention of my own, and that the experimental apparatus at Christiana was erected by myself, under the sanction of the late Secretary of the Treasury, the Hon. J. C. Spencer, by whose authority a practical investigation of and report was made upon the same, by Captain Henry Prince, of the revenue marine, to which report I would refer for many important practical results not enumerated or alluded to in the report of Messrs Johnson, Cresson, and Smith.

I claim for my invention—

1st. That it will afford the steadiest, most uniform, safe, and brilliant light that can be used in light-houses.

2d. That supposing lard to be applicable to the purpose, (which, for the reasons I have before adduced, I do not hesitate to deny,) my apparatus will impart greater light at one-fifth the cost of lard, and at one-fifteenth the cost of oil.

3d. That the difference in the cost of oil and gas will in five years defray the whole expense of erecting houses, apparatus, and fixtures, for the manufacture and introduction of gas in all the light-houses in the Union; and that thereafter it will save to the Government about $100,000 annually—more than sufficient to pay all the salaries of the light-house keepers.

Before closing this communication, I cannot avoid, as a friend of science, and apart from any personal interest which I might be supposed to have in the subject, expressing the gratification which the perusal of a major portion of the report of the examining board has afforded me, and which it cannot fail to impart to all who desire the diffusion of scientific knowledge and the adoption of scientific improvements. For the acknowledgment of the complete success of my invention, I am constrained to be grateful, however much I may regret their errors of calculation and the omission of important facts from their report. For the earnest testimony they bear to the superiority of gas over the material now used in our light-houses, as well on the score of brilliancy and safety as economy, and the satisfactory manner in which they dispel the mists in which ignorance or the prejudice of habit sometimes for a period successfully envelopes every improvement on its first introduction, I can excuse the respectable gentlemen who composed the board for their failure to indicate with greater precision and clearness those portions of my apparatus which claim the merit of originality.

I should be much pleased to have this statement submitted to the Com-
mittees on Commerce in the Senate and House of Representatives, to-
gether with Captain Prince's report, when you present that of Messrs. Johnson and his associates.

Very respectfully, your obedient servant,

BENJAMIN F. COSTON, U. S. N.

Hon. G. M. Bibb,

Secretary of the Treasury.

Collector's Office,

Wilmington, Delaware, January 18, 1845.

SIR: In answer to your letter of the 10th instant, enclosing certain "papers touching the comparative advantages between the use of lard, or other oil, and gas, in the light-house establishment," I have the honor to submit the following remarks:

First. As to the actual cost of materials for making gas.

The gas consumed by five burners at the Christiana light-house in 196 nights, say from the first day of June to the 31st day of December, 1844, both inclusive, except 18 nights in the month of September, when the gas was suspended, and oil used, on account of being obliged to build a new chimney in the gas-house, was made from the following materials, viz: Fourteen and a half barrels of rosin, at 85 cents per barrel, amounting to $12 32½; 118 bushels of coke, at 6½ cents per bushel, $7 37½; 1½ ton anthracite coal, worth $5 55; 1 bushel of fire clay, cost 50 cents; 1½ cord of wood, cost $7.50—amounting in the whole to $33 25; which sum, divided by 196 nights, gives 16.96 cents as the cost per night, for materials used, or $61.904 per annum.

Admitting, then, that the average consumption of gas at the Christiana light-house is about 160 feet for five burners per night, which is believed to be very near the quantity consumed, it follows that 31,360 feet of gas has been produced from 14½ barrels of rosin, which, if estimated at 300 lbs. per barrel, would be 4,350 pounds of rosin. It is proper to say, however, that the weight of rosin consumed is not known, and the keeper informs me that there were some small barrels, and some of the others were not full.

Second. As to the cost of lard.

Less than five burners, whether of gas or lard, would be insufficient for the light-house at Christiana; and the value of the lard necessary to maintain five burners one year would be, according to the estimate of the committee of examination, $171 87.

Third. As to the cost of oil.

Before the introduction of gas into the Christiana light-house, there were eight lamps used, (and this is the least number of oil lamps that would be sufficient,) which consumed, during the year 1843, 344 gallons of oil, which, at 91 cents per gallon, the average cost of oil during the present year, would amount to $313 04; and yet, for all practical effect, the amount of light produced by the gas is at least double of that pro-
duced by the eight oil lamps, although the expense of the materials con-
sumed bears so small a proportion to the cost of the oil.

The above statements, as to the cost of the materials for gas, and the
consumption of oil, are taken from the returns of the keeper of the light-
house, and are believed to be correct.

**Fourth.** As to the fitness of gas for light-houses.

I entirely agree with the committee in all they say as to the fitness of
gas for light-house purposes; its safety from danger of explosions; its
suitableness for fixed or revolving lights, or for reflectors or lenses; and
its burning freely in any known natural temperature.

**Fifth.** Relative advantages.

Inasmuch as lard cannot be introduced into our light-house establish-
ment, for want of a suitable lamp to burn it in the focus of the reflectors
used in our light-houses, and as it is problematical whether such a lamp
can be invented, I shall not pursue the comparison between lard and
gas as a means of lighting light-houses; although gas, it must be appar-
ent, would have many advantages over lard, even if there were no me-
chanical difficulties in the way of its use.

From the results obtained with our experimental apparatus at Christi-
ana it is apparent, that lighting up light-houses with gas will be much
cheaper than with oil, unless the apparatus shall be too costly in its
original structure, or too expensive to keep in repair.

It is believed that the gas-house and all the apparatus for generating
gas may be erected, except in unfavorable situations, for from twelve to
fifteen hundred dollars. From the materials and structure of the appa-
ratus, no other parts appear liable to get out of order, or to involve much
expense of repair, except it be the furnace, retort, grate bars, and shield
for retort. These would probably have to be renewed annually, and
not oftener, and would cost at our foundries about the following prices:
Retort, $17; grate bars, $3; cast-iron shield for retort, (in place of soap-
stone, now used,) $8; fire-brick, $9; setting new retort, $4—amounting,
for repairs of furnace, retort, &c., to $41.

The gas-house, if well built, would require so little to keep it in re-
pair, that it would scarcely be necessary to make an estimate for it.
This, added to the cost of materials for making gas, would make $102 90
per annum, or about 28.2 cents per night. I have said nothing about
the interest on the original cost of the gas-house and apparatus.

The expense of oil for Christiana light-house in 1843, as before
stated, at 91 cents per gallon, was................... $313 04
Add for wicks, tube-glasses, and repairs of lamps. .......... 13 00

Making for the year........................................... 326 04
or about 89.3 cents per night, or 3.166 times as much as gas.

I would observe that Mr. Coston has shown me the model of an im-
proved furnace and condenser, which I think will be at least equally ef-
fective as those now in use, while it is more simple, less costly, and more
easily repaired, and I think its introduction into our light-house at
Christiana would materially lessen the annual cost of repairs.
In the foregoing observations as to the comparative advantages of lighting the light-house establishment with gas, or lard, or other oil, I have only presented data which I think may have an important bearing upon the subject; and these are drawn from the experience derived from seven or eight months' use of an experimental gas apparatus, which I believe may be improved, and the actual consumption of oil at the same light-house during the year 1848.

The papers received with your letter are herewith returned.

I have the honor to be, most respectfully, your obedient servant,

Hon. George M. Bibb,
Secretary of the Treasury.

---

Report on the gas-light apparatus, invented and erected by Benjamin F. Coston, now used at the light-house at the mouth of Christiana river, in the State of Delaware, by a committee appointed for that purpose.

Superintendent's Office,
Wilmington, Del., December 19, 1844.

Sir: I have the honor to transmit the report of Messrs. Walter R. Johnson, John C. Cresson, and George W. Smith, on the gas-light apparatus used at the light-house at the mouth of the Christiana river, made in pursuance of your letter dated the 30th of October, 1844.

It appears to me that many important facts on the subject of generating light are brought forward in this report, which may be turned to great advantage in the light-house establishment of the United States. The great desideratum, however, to profit by the most important fact elicited, viz: the superior cheapness and efficiency of lard in the production of light, seems to be to secure the construction of a lamp which will burn lard in the focus of our reflectors. This cannot be done with our present light-house lamps. The lard could not be kept in a state to flow into the burner. I have no doubt, however, that this difficulty can be obviated by an ingenious lamp maker, and should it meet your approval, I will endeavor, with as little expense as possible, to have such a lamp constructed.

The whole expense necessary for the introduction of lard in our light-houses would be new lamps, which, when a proper pattern was made, could not exceed $4 to $5 each—an inconsiderable sum, when compared with the saving of two-thirds of the expense of the oil now consumed.

I have the honor to be, most respectfully, your obedient servant,

ARNOLD NAUDAIN,
Superintendent.

Stephen Pleasonton, Esq.,
Fifth Auditor, &c.

27 L H P
Letter from Arnold Naudain, Esq., collector and superintendent of light-houses at Wilmington, Delaware, to Walter R. Johnson, John C. Cresson, and George W. Smith.

Collector's Office, Wilmington, November 15, 1844.

Gentlemen: I have been directed by Mr. Pleasonton, the general superintendent of the light-houses in the United States, to cause the Christiana light-house, which has been fitted up for the use of gas, to be inspected by three scientific and disinterested persons, for the purpose of reporting upon the fitness of gas for light-houses, &c.

I would, therefore, respectfully invite you to inspect the said light-house, and the gas apparatus attached thereto, and to report thereon, in conformity to the instructions of Mr. Pleasonton, contained in his letter dated 30th ultimo, a copy of which I have the honor to enclose.

I am, gentlemen, most respectfully, your obedient servant,

ARNOLD NAUDAIN,
Collector, &c.


REPORT, &c.

Philadelphia, December 16, 1844.

Sir: Your letter to us of the 15th November, 1844, has been duly received, accompanied by one from the general superintendent of light-houses in the United States of which the following is a copy:

"Treasury Department,
"Fifth Auditor's Office, October 30, 1844.

"Sir: I intended, as I informed you some time ago, to have joined you about this period in the inspection of the gas-light at the mouth of the Christiana river, but now find it out of my power. As it will be necessary to make a report to Congress in relation to this light at the next session, I am desirous of having it examined by three scientific and disinterested men, and a report made by them as to its fitness for light-houses, its advantages and disadvantages, and its economy or otherwise, in relation to other kinds of lights, and as to whether the mode of generating the gas is an improvement, or is made upon the principle generally adopted. If an improvement, to state in what it consists.

"You will be pleased to select three such gentlemen, either in Wilmington, Philadelphia, or Baltimore, and invite them to inspect the works at Christiana, and report to you their joint opinion on the several points indicated above, and particularly whether, from the explosive nature of gas, it would be advisable to adopt that mode of lighting our light-houses, with keepers ignorant of nearly all the properties of gas.


"You will pay the expenses of these gentlemen, it being presumed that they will charge nothing for their services. You will be pleased to give Mr. Coston, the author of these works, notice of the time these gentlemen may appoint to enter upon this investigation.

"I have the honor to be, respectfully, sir, your obedient servant,

"S. PLEASONTON.

"ARNOLD NAUDAIN, Esq.,

"Superintendent of Lights, Wilmington, Del."

In compliance with your invitation, and in conformity with the above letters, we have visited the light-house near Wilmington, and, together with Mr. Joseph Cresson, who obligingly volunteered to aid us with his practical experience in making observations and experiments, have applied the necessary means to decide the several questions submitted for investigation.

As, in matters of practical science and the useful arts, little reliance is at the present day placed on mere opinions, unless sustained by facts well authenticated, observations which can be repeated, and experimental results which can be reproduced, we felt assured that rigorous methods of trial could alone be of much service to the department which sought the information.

To aid in conducting these trials, a portable gas metre from the Philadelphia gas works, together with the necessary attachments: some burners for comparative trials, a syphon gauge to ascertain the pressure under which the gas flowed, and a suitable receptacle for bringing a quantity of the gas to Philadelphia, were provided by Professor Cresson. A reflecting photometer, on the plan of Dr. Ritchie, was kindly loaned to the committee by Professor Frazer, of the University of Pennsylvania. A fine solar lard lamp, to serve as a standard, was obligingly prepared, at our request, by Messrs. Cornelius & Co. Other necessary instruments were procured by different members of the committee, which, together with the necessary weighing apparatus that you were able to procure in Wilmington, afforded the means of proving experimentally all the points which we considered important in order to answer Mr. Pleasonton's inquiries. In all our examinations at the light-house, we had the advantage of the attendance of Mr. Coston, under whose direction and superintendence the gas apparatus was constructed.

The principal parts of that apparatus are—

1st. A copper receptacle of a cylindrical form, for melting the rosin out of which the gas is generated. To this is attached, near the bottom, a tube, furnished with a stop cock, to regulate the flow of rosin according to the demands of the process.

2d. A retort, of cast iron, four feet long and ten inches interior diameter, lying in the furnace in the usual horizontal position. The mouth of the retort projects about three inches in front of the brick-work* in which it is set. At fourteen inches from the front of the retort, and consequently within the furnace, is a vertical tube, three inches in diameter.

*In the New York rosin gas works the retorts are set in a furnace, the outer casing of which is of cast iron. This may probably be, on the whole, an economical arrangement.
through which flows the melted rosin by a tube of much smaller diameter, and which opens into the upper part of an air-tight box. Into this box, near the bottom, opens another tube, which passes through the lid, and has at its upper extremity a funnel to receive the melted rosin coming from the receptacle already described. The air-tight box serves as a seal, and in place of the syphon elsewhere employed for similar purposes. When in use, the retort is filled with coke, of which it holds about one and a half bushel.

3d. The condenser consists of a cast-iron neck, connected by a flange, and bolts to the rear end of the retort; a tar chest, four feet long and twelve inches square outside, and six iron tubes, three inches in diameter and ten feet high, rising from the top of the chest, connected two and two at top, with suitable partitions descending into the tar, to cause the gas to traverse all the tubes. The neck of the retort is surrounded by a copper jacket, to contain cold water, which it receives from the lower part of the water cistern of the gasometer, by a tube entering near the bottom of the jacket, and which it discharges by another tube passing from its upper part to near the top of the same cistern.

4th. The tar well, which receives the condensed tar from the chest above described, and from which it is pumped by hand into buckets, to be returned to the receptable for melting resin.

This tar well is made of brick, and having been constructed in cold weather, and used without full time to become dry, allows a slight leakage of tar, which finds its way into the cellar. This inconvenience might have been avoided, and may now be remedied at a trifling expense, by using in place of it a cast-iron bath tub, or other light receptacle of the same material, capable of holding two or three barrels.

5th. The gasometer and its cistern. The former is a sheet-iron cylinder of the usual form, open at bottom and closed at top, ten feet in diameter, and the same in height, containing seven hundred and eighty cubic feet; the latter is a wooden vat or tub, of somewhat larger dimensions, containing the water into which the former descends. A three-inch tube, coming from the upper part of the tar chest, and thence descending below the floor of the gas-house, enters the bottom of the cistern, (which also descends below the floor,) and thence rises to and opens above the top of the water in the cistern, and of course within the gasometer, to which this tube conveys the gas from the condenser. Any tar condensing in this tube finds an exit from its lowest part by a syphon placed there for its discharge. The weight of the gasometer (1,400 pounds) is counterpoised by a cast-iron counterweight, attached to it by two chains passing over pulleys, and is thus made capable, by an increase or diminution of the latter, of dilating or compressing the gas to any required degree. The cistern is supplied with rain water from the roof; any excess being carried off by a tube, or regulating spout, placed at the required level. The vertical motion of the gasometer is insured by an iron rod descending from the ceiling of the gas-house to the bottom of the cistern, passing through a tube three inches in diameter, fitted centrally to the top of the gasometer, and descending to the level of its lower edge, with braces to maintain its position.

6th. The conducting tube and burners. The gas is conveyed from the
gasometer by a tube one inch in diameter, first horizontally about thirty-five feet, and then vertically to the height of about forty feet above the level at which it leaves the gasometer. At the level of the deck of the lantern is a mercurial seal, from which rises that part of the vertical tube which receives the five horizontal arms conveying gas to the burners. Its upper end is supported by a ring, in which it turns freely, allowing the arms to be placed in any desired direction. The burners are constructed on the Argand principle, each containing twenty holes or jets, in a ring of one and one-eighth inch in diameter. The support of the glass tube which surrounds the flame of each burner is furnished with a cone somewhat on the solar principle, but not rising higher than the ring which contains the jets. The centre of each flame is nearly in the focus of a parabolic mirror, of plated copper, fourteen inches in diameter. The addition of the usual machinery and movable power would readily convert this into a revolving light. From the foregoing description, it will be seen that every part of this apparatus is very simple and intelligible.

Having, on the 21st November, inspected the apparatus, gas-house, and lantern, we proceeded to examine the quality of the gas remaining in the gasometer. For this purpose a branch pipe, which leads to the dwelling part of the premises, was employed. Having detached the burner, we connected with this pipe the experimental metre above mentioned, and, allowing the gas to flow, attached the syphon gauge, which showed that the gas was under a compression equivalent to four-tenths of an inch of water, the counterweights of the gasometer remaining in the same condition as on the previous night.

We next attached to the exit tube of the metre a double-coned Argand gas burner, with fourteen jets or holes, around a ring thirteen-sixteenths of an inch in diameter; which being lighted, the metre was observed for ten minutes, and found to be delivering gas at the rate of 2.25 cubic feet per hour, the thermometer standing at 68°. The lard standard lamp, which had been previously prepared and lighted, and its flame duty regulated to the height of three inches, was now compared with the gas flame, by placing the reflecting photometer immediately between them. By carefully adjusting the distances of the two flames, so as to make as usual the reflected light from each equally bright, the centre of the photometer was found to be distant from the centre of the lard flame 68.9 inches, and from that of the gas flame 41.25 inches. Hence the gas flame is at present represented in intensity by 1701.52, and the lard flame by 4747.21, or the standard lard is to the gas flame as 1 to 0.3584; so that the lard light is 2.79 times as powerful as the gas.

2. Having attached one of Mr. Coston’s light-house burners, above described, we allowed the gas to flow without altering the stopcock which regulated the supply of gas in the preceding experiment. Again observed the flow of gas through the metre, and found it to be 2.17 cubic feet per hour, temperature 66°. Measured the distances from centre of photometer as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>To centre of standard solar lard flame</td>
<td>68.1</td>
</tr>
<tr>
<td>To that of Mr. Coston’s Argand gas flame</td>
<td>41.3</td>
</tr>
</tbody>
</table>

Hence the intensities are as 4637.61 to 1705.69, or as 1 to 0.3678; and the lard light is 2.71 times as powerful as the gas.
3. Tried the above experiment again, after the gas burner had become heated to the boiling point of water. Then the distances were——

To lard flame .................................................. 67.75
To gas flame ................................................. 41.3 as before.

The intensities were, therefore, as 4590.06 to 1705.69, or as 1 to 0.3716; and the lard light was 2.69 times as powerful as the gas-light. Immediately after completing this observation, the gas was found to be passing the metre at the rate of 2.16 cubic feet per hour.

4. Having cleaned the glass tube, or chimney of the gas flame, the lights were again compared:

Distance from standard lard flame ....................... 67.0
Distance from gas flame ................................... 42.12

The illuminating powers are consequently as 4489.00 to 1774.09, or as 1 to 0.3952; so that the lard light is 2.53 times as powerful as the gas light. The gas came through the metre, by a mean of ten sets of observations, taken immediately after this comparison, at the rate of 2.375 cubic feet per hour, temperature 72°. The slight discrepancies in the rates of flow in the several trials may be accounted for by the friction of the pulleys over which the supporting chains of the gasometer pass, being liable to some inequalities, especially at the very moderate preponderance which the gasometer had over its counterweight. It appears that the gas gained gradually upon the lard in intensity——

The latter being by the first trial, 2.79 times as strong as the gas.
Do. do. second trial, 2.71
do. do.
Do. do. third trial, 2.69
do. do.
Do. do. fourth trial, 2.53
do. do.

And the mean being ....... 2.68

5. Immediately after the preceding trial and observation in the rate of flow, the gas flame remaining unaltered, we made a comparison between it and one of the lamps which had been used in the lantern of the light-house previously to the introduction of gas. It had been trimmed and prepared, and its flame adjusted by the keeper, to correspond as nearly as possible with his usual practice. The distances from the centre of the photometer were now as follows:

To the centre of oil flame .................................. 49.9
To that of gas flame .......................................... 56.3

Or the oil is to the gas as 2490.01 to 3169.69; and the oil flame is therefore only 0.785 as powerful as the gas flame.

By a comparison between the two preceding experiments, and using the gas flame as a standard between oil and lard, the former burned as in the light-house, and the latter with a standard flame three inches in length, they are found to stand thus: lard, 2.53; gas, 1; oil, 0.785; showing that between the lard flame and the oil flame, thus used, the relative illuminating powers are as 3.223 to 1—making the lard light unity, the oil light is 0.3103.
In all the experiments thus far, the gas had been burned more slowly than in the lantern of the light-house, the flame being constantly less than two inches in length.

6. Now admitted more gas to pass, producing a flame exactly two inches high. Observed the metre for ten minutes, and found it to be delivering 2.69 cubic feet of gas per hour. Compared the light with that of the lard standard:

<table>
<thead>
<tr>
<th>Distance</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>of lard standard</td>
<td>61.5</td>
</tr>
<tr>
<td>of light-house gas flame</td>
<td>51.1</td>
</tr>
</tbody>
</table>

The intensities are therefore 3782.25 and 2611.21; showing that the lard light is now to the gas light as 1 to 0.6904, or as 1.448 to 1.

7. Keeping the regulating stopcock of the gas pipe exactly as in the last experiment, the oil lamp, regulated as before, was now brought directly into comparison with the gas as burned in the light-house. The result was:

<table>
<thead>
<tr>
<th>Distance</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>from centre of gas flame to photometer</td>
<td>55.3</td>
</tr>
<tr>
<td>from the oil flame</td>
<td>39.0</td>
</tr>
</tbody>
</table>

And the relative powers of the lights were 3058.09 and 1521.00, or gas light is to oil light as 1 to 0.4973. This trial, with the one immediately preceding, offered another comparison between the lard and the oil lights.

Thus—lard, 1.448; gas, 1; oil, .4973; gives the lard to the oil as 2.911 to 1; or, making the lard light unity, the oil light is 0.3435.

Immediately after the above photometrical observations had been completed, the metre was again observed for ten minutes, and the rate of flow found to be 2.725 cubic feet per hour. Hence the two sets of observations taken since adjusting the gas light to that of one of the burners in the lantern, give

\[
\frac{2.69 + 2.725}{2} = 2.707 \text{ cubic feet per burner per hour.}
\]

At this rate, the five burners in the lantern will consume in twelve hours 162.42 cubic feet.

After the above experiments had been completed, a portion of the gas was used for the light-house before making our next trials, which took place on the day following, (November 22.)

To test the actual consumption of lard by the solar standard lamp, and of oil by the Argand lamp of the light-house already tried, they were this morning filled to the usual height, properly trimmed, and weighed. The lard lamp burned from 10 hours 9 minutes a. m., till 5 hours p. m.; consumed 6,505 grains, or .929 of a pound, in 6.85 hours, being at the rate of .1356 of a pound per hour.

The oil lamp was burned from 11 hours 42 minutes a. m. to 5 hours p. m., or 5.5 hours, during which it consumed 2,576 grains, or .368 of a pound, being at the rate of .069943 of a pound per hour; and, as oil weighs 7.6 pounds per gallon, this gives .009267 of a gallon per hour; and for 8 lamps, 12 hours, .889632 of a gallon, which is 324.7 gallons per annum.
By an examination of the books kept at the light-house, and containing a registry of the quantity of oil actually consumed while 8 oil lamps were employed, we found that, for the year 1843, it was—

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>First quarter</td>
<td>109</td>
</tr>
<tr>
<td>Second quarter</td>
<td>76</td>
</tr>
<tr>
<td>Third quarter</td>
<td>67</td>
</tr>
<tr>
<td>Fourth quarter</td>
<td>72</td>
</tr>
</tbody>
</table>

And hence the total for the year was.............. 324

Which is within a fraction of a gallon of what our experiment and computation make it. It is true that a small portion of the oil supplied in that year was burned in hand lamps, lanterns, &c., for the use of the keeper; but this cannot materially affect the general result, which proves that the lamp which we weighed was trimmed and burned with a remarkable conformity to the general practice. It probably consumed more oil, and gave more light, than its average in the lantern. We have assumed 12 hours to be the average length of a light-house night, because the lamps are always lighted at sunset and extinguished at sunrise.

8. About 20 minutes after lighting the lard lamp, a comparison was made between its light and that of the gas as burned in Mr. Coston’s apparatus. The distances were—

<table>
<thead>
<tr>
<th>Source</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the lard</td>
<td>67.5</td>
</tr>
<tr>
<td>From the gas</td>
<td>47.1</td>
</tr>
</tbody>
</table>

The relative amounts of light are, therefore, from lard 4556.2, and from gas 2218.4, or they are to each other as 2.053 to 1. The quantity of gas passing the metre during this trial was 2.64 cubic feet per hour.

9. In the preceding experiment, the gas flame did not appear to be quite two inches in height. The regulator cock was therefore opened a little more, to give it the standard height. The distances were then—

<table>
<thead>
<tr>
<th>Source</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>From lard—flame</td>
<td>65.8</td>
</tr>
<tr>
<td>From gas—flame</td>
<td>48.6</td>
</tr>
<tr>
<td></td>
<td>power</td>
</tr>
<tr>
<td>From lard</td>
<td>4329.6</td>
</tr>
<tr>
<td>From gas</td>
<td>2862</td>
</tr>
</tbody>
</table>

Hence the lard light is to the gas light as 1.833 to 1. Though immediately after this set of observations the metre indicated only 2.43 cubic feet of gas per hour, yet the relative illuminating power of the gas had evidently increased. The cause of this may probably be attributed to the gradual heating up of the burner, which had now attained a temperature of more than 212°. The same relative increase of power on the part of the gas had been observed on the previous day’s trials. From the mean result of the two trials this day, it appears that the lard light was to the gas light as 1.943 to 1.

Immediately after the completion of the preceding experiment, the gas metre was detached, and about two gallons of the gas collected in a bottle filled with and inverted over water; the vessel corked under water, and sealed as soon as filled, to be taken to Philadelphia. When subsequently examined on the 28th November, this gas was found to have a
specific gravity of .8093. As it is known that rosin gas generally varies in specific gravity from .75 to .85, it appears that the gas manufactured by the keeper of the Christiana light-house was, on the last night on which it was used, of fair medium quality, about 43 per cent. superior in density to ordinary coal gas, and, according to one mode of determining the illuminating powers of gases, ought to have about the same superiority in this respect over that material.

A portion of it, burned after the specific gravity had been ascertained, gave a flame of great cleanliness and brilliancy.

After completing the comparison of lights, and collecting the sample of gas, we again proceeded to the gas-house, to observe the process of generating gas, the quantity of materials employed, the rate at which the gasometer was filled, and other circumstances of the operation. Some gas still remained in the gasometer, its upper edge being 28 inches above the top of the cistern. The fire under the retort had been lighted before our arrival, and had occupied, as stated by the keeper, about 4 hours in bringing it to a temperature of cherry redness, fit for receiving the supply of rosin. We found the latter already melted, and within about two inches of the top of the screen or strainer, which is placed in the receptacle, to prevent impurities from entering the supply tube. At 12 o'clock m., the operation was commenced, by turning the stopcock, and allowing the rosin to flow into the funnel, descend thence into the seal already described, and thus pass into the retort. In the early part of the process, the gas came over rapidly. The gasometer rose 11 inches in 22 minutes, showing the production to be at the rate of 196 cubic feet per hour. Arrangements had been made to collect separately all the tar which should be produced this day, and not to allow it to mix with that already in the tar well. In the early stages of the process, the tar flowed freely; and portions of it were from time to time measured and returned as usual to the receptacle for melted rosin, and aiding to dissolve the fresh portions of that material, to pass again into the retort.

The operation was continued from the time above mentioned, in the manner indicated in the following schedule, without interruption or difficulty of any description, and until the gasometer was filled to its usual height, when the further supply of rosin was cut off. From this tabular view, it will be perceived that 486 cubic feet of gas resulted from the consumption of 70 pounds of rosin, and that no other material than the tar derived from its distillation was added; and this is in fact no addition, but only a returning repeatedly, to the retort, of those portions which escape decomposition the first time they are admitted.
Tabular view of the operation of generating gas, November 22, 1844.

<table>
<thead>
<tr>
<th>Hour of observation</th>
<th>Pounds of rosin supplied to the time of each observation</th>
<th>Quarts of tar distill ed over and returned to receptacle</th>
<th>Indice of rise from commencement of observations</th>
<th>Cubic feet of gas generated, from commencement to the time of observation</th>
<th>Rate at which gas is generated in cubic feet per hour</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. M. h. m.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>Commenced supplying rosin to the retort.</td>
</tr>
<tr>
<td>0 22</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>72.00</td>
<td>196.35</td>
<td>First gallon of tar supplied to the receptacle.</td>
</tr>
<tr>
<td>0 45</td>
<td>16</td>
<td>0</td>
<td>18.5</td>
<td>121.09</td>
<td>125.05</td>
<td>Weighted a bucket full of the rosin, (pulverized,) as taken from the barrel, and found it 16 lbs.</td>
</tr>
<tr>
<td>0 47</td>
<td>22</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 00</td>
<td></td>
<td></td>
<td>24.0</td>
<td>157.09</td>
<td>144.00</td>
<td></td>
</tr>
<tr>
<td>1 03</td>
<td>38</td>
<td>8</td>
<td>44</td>
<td>292.05</td>
<td>134.96</td>
<td></td>
</tr>
<tr>
<td>2 00</td>
<td>54</td>
<td>12</td>
<td>44</td>
<td>292.05</td>
<td>134.96</td>
<td></td>
</tr>
<tr>
<td>2 02</td>
<td></td>
<td></td>
<td>16</td>
<td>292.05</td>
<td>134.96</td>
<td></td>
</tr>
<tr>
<td>2 23</td>
<td>68</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 32</td>
<td>58</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 00</td>
<td>66</td>
<td>24</td>
<td>64 13-16</td>
<td>424.17</td>
<td>132.12</td>
<td>A quart of tar weighed when warm 2 lbs. 23 oz. Its specific gravity was 1.153, when at 60°. All the tar hitherto produced has now been returned to the receptacle for melting rosin.</td>
</tr>
<tr>
<td>3 07</td>
<td>70</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 34</td>
<td>71 9-16</td>
<td></td>
<td>468.35</td>
<td>73.96</td>
<td></td>
<td>Ceased supplying rosin to the retort, which henceforth acts only on the materials already admitted.</td>
</tr>
<tr>
<td>4 10</td>
<td>74 5-16</td>
<td></td>
<td>486.45</td>
<td>30.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The heat required to raise temperature and to generate the gas was furnished by burning $2\frac{1}{2}$ bushel of coke, (including 1$\frac{1}{4}$ bushels which had filled the retort in the preceding operation,) and about $\frac{1}{12}$ of a cord of wood of inferior quality. A very slight oozing of tar from one of the flanges connecting the retort with the tar chest was the only indication of any want of accuracy in the junctures of the apparatus; and this did not in the least interfere with its success. While producing gas, the counterweights of the gasometer were made heavier than the gasometer itself, tending thereby to raise the latter out of the water, and rather to draw the gas from the retort, to aid its passage through the tar chest and condenser, than to compel it to force its way into the gasometer against a pressure above that of the atmosphere. This prevents the escape of gas into the house.

As soon as the process was completed, we took occasion to observe the quality of the gas just produced, and judged it superior in brilliancy to that on which our first trials had been made. This might be expected, from the well-known fact, that, by remaining for some time.
over water, gas will deposit those vapors of the liquid hydro-carbons, which give it at first a brilliancy beyond that which it displays when perfectly deprived of such vapors.

From the experiments and observations which we were enabled to make, we consider that the gas tried in our first day's operations was of a medium quality between the fresh gas just made and that tried this day, before filling the gasometer.

On two successive evenings we saw the lantern lighted up in the regular manner, noticed the height of the flames, as compared with that employed in our experiments, and observed from different distances the great brilliancy which it presented; and though we could not in this manner compare the present appearance of the light-house with that which it exhibited when oil was used, yet the experiments we have detailed afford a more accurate criterion of the relative illuminating powers of the respective materials than could be derived from actual observations, even had two light-houses for such a purpose been placed side by side.

Having now stated all the observations and experiments which our time, necessarily limited by other engagements, enabled us to make, we will proceed to a consideration of the several inquiries raised by Mr. Pleasonton.

1. The fitness of gas for light-houses.

On this point we do not entertain the smallest doubt, either as it regards gas in general, or the particular kind of gas produced by the apparatus at the Christiana light-house. The latter, as we have shown, has a density and illuminating power much superior to that derived from coal alone, which is used in many of our large cities.

The same reasons which in the latter situations recommend gas for the multifarious purposes requiring fixed and invariable lights, are even more cogent in the case of light-houses.

The steadiness, brilliancy, and extensive range of the light; the absence of all demands upon the attention of the keeper, after the gas has been lighted for the night; and its flow duly regulated; the easy adaptation of it to revolving lights, where such are required; the small obstruction which the burner itself opposes to the rays of light reflected from parabolic mirrors, where, as in most of our light-houses, the catoptric principle is applied; the perfect facility of combining its use with leuses, where the dioptric or lenticular light is employed; its comparative freedom from smoke, and from a tendency to soil glasses and reflectors, thus saving the rapid deterioration of the latter; its exemption from the use of wicks, and from their multiplied annoyances, (to say nothing of their expense,) all indicate its fitness for the purposes of the light-house.

2. Its advantages and disadvantages.

Its advantages are to be found, mainly, in the circumstances just stated, together with its equal applicability at all seasons of the year, not requiring, as in the case of oil; a different article in winter from
that which may be used in summer. The materials for making gas are of a nature to remain in store a long time without undergoing deterioration; whereas both oil and lard become less valuable if kept a great length of time, unless preserved in vessels hermetically sealed. The burners of gas are easily managed and regulated. The degrees of luminousness of the flame of rosin gas is very constant after the burner has come to a stationary temperature. The quality of the gas itself is not so liable to vary, as is that of gas produced from coal, and it requires no purification.

The principal disadvantage of using gas in light-houses, where the latter are so situated as not to receive their gas from extensive gas works, is the expensiveness of the apparatus for producing it. The apparatus, however, which has been put up at the Christiana light-house, being the first erected for this particular purpose in this country, and subjected to several alterations in bringing it to perfection, is not to be taken as a criterion of the cost of future establishments of the same size. A little more intelligence and skill is required in the keeper who manages gas than in him who has only to take care of ordinary oil lamps. The mechanical skill, however, demanded for this service is by no means so great as what is represented to be requisite to manage and keep in order the mechanical or carcel lamps used in the light-houses at Navesink, where the French lenses are employed.*

The fact is worthy of notice, that the present keeper of the Christiana light, Mr. Crozier, had not the advantage of any practical acquaintance with gas previous to its introduction into the house under his care; and we have understood that, prior to taking charge of that establishment, his employment had been that of a shoemaker. A disadvantage attendant on the use of gas in very cold climates arises from the danger of freezing the water of the cistern containing the gasometer. This might in many places be obviated by filling the cistern with the purest portion of the tar produced from the operations of the works, which we have found abundantly fluid at 100° Fahrenheit, and which probably would be found so several degrees lower.

3. The Economy of Gas-Light, as Compared with Other Kinds of Light.

With respect to this, we would state that something will depend on the situation of the light-house to be supplied with respect to the sources of supply of the several materials. If a light-house were required at Cincinnati, Louisville, or St. Louis, and the question lay between lard, oil, and rosin, we ought to expect the relation to be more in favor of lard than at any point on the Atlantic coast; if at Nantucket or New Bedford, the relative advantage of oil would naturally be greater than at Philadelphia or at New Orleans, and much more would it be greater than at Cincinnati. In any part of the coast of North Carolina, rosin

---

*The two light-houses at Navesink, could both be supplied from the same gasometer. Bude burners would increase the efficiency of the gas; the mechanical difficulties so much objected to in the carcel lamps be avoided, and the burner be kept invariably in the focus of the lenses.
ought to be expected to possess a higher relative advantage than at any point remote from that great source of supply. But the actual market is the true criterion, so far as the price of materials determines the cost of light. To this, therefore, we resort in the present instance.

Having consulted the prices current of Boston, New York, Philadelph,ia, Norfolk, Charleston, New Orleans, and Cincinnati, for the day following that of our experiments, (viz: November 23, 1844,) we have been enabled to furnish the following table of prices of the three materials of which we have compared the illuminating power:

**Prices of oil, lard, and rosin, in the principal markets for those articles in the United States, November 23, 1844.**

<table>
<thead>
<tr>
<th>Market at which the prices are given</th>
<th>Authority furnishing the prices</th>
<th>LARD. Price, in cts., per pound.</th>
<th>OIL. Price, in cts., per gallon.</th>
<th>ROsin. Price, in cts., per barrel of 300 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lard.</td>
<td>Oil.</td>
<td>Roisin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Winter strained.</td>
<td>Spring and fall strained.</td>
<td>Summer strained.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boston ...</td>
<td>Boston Shipping List:</td>
<td>6 a 6</td>
<td></td>
<td>100 a 102</td>
</tr>
<tr>
<td>New York ...</td>
<td>New York Commercial and</td>
<td>6</td>
<td>a 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shipping List:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philadelphia ...</td>
<td>Philadelphia Commercial</td>
<td>5 a 6</td>
<td></td>
<td>100 a 110</td>
</tr>
<tr>
<td></td>
<td>List and Price Current:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norfolk ...</td>
<td>Norfolk Beacon:</td>
<td>6 a 6</td>
<td></td>
<td>100 a 110</td>
</tr>
<tr>
<td>Charleston ...</td>
<td>South's Patriot and Charles-</td>
<td>5 a 7</td>
<td></td>
<td>100 a 110</td>
</tr>
<tr>
<td></td>
<td>ton Courier:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Orleans ...</td>
<td>New Orleans Price Current:</td>
<td>5 a 6</td>
<td></td>
<td>100 a 110</td>
</tr>
<tr>
<td>Cincinnati ...</td>
<td>Peabody's Price Current and</td>
<td>4</td>
<td>a 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Daily Chronicle:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The lard used for burning in lamps is generally inferior to that employed for culinary purposes, and is called "No. 2," in the Cincinnati market. Assuming that by purchasing on contracts large quantities of these several articles, for cash, the Government would obtain them at prices, respectively, proportionate to the minimum rates here quoted, we find that for the Atlantic seaboard and the Gulf of Mexico, the relative prices will, on an average of five markets, for lard, be 5.8 cents per pound; of six markets, for winter oil, be 101.6 cents per gallon; for five markets, for spring and fall oil, 97.0 cents per gallon; of three markets, for summer oil, 86.6 cents per gallon; of six markets, for rosin, 65.8 cents per barrel.

We have been informed, by Mr. Coston, that the rosin used at the light-house cost 85 cents per barrel; and by the general superintendent of light-houses, in a communication hereto annexed, that the contracts for oil for the present year have been in the spring at the prices following:

For spring oil, 78 cents per gallon; for winter oil, 85 cents per gallon.

In the autumn it has been—

For spring oil, 90 cents; for winter oil, 93 cents.

*The price of rosin per barrel, in New York and Philadelphia, is supposed to refer to barrels of 250 pounds; the papers do not, however, discriminate in this particular. We have heard of 300-pound barrels being sold as low as the mean minimum of the Atlantic markets since the date to which these prices refer. This day, (December 16,) 650 barrels, of 300 pounds each, have been sold at 65 cents per barrel, delivered on the wharf above Kensington.
The contracts for our light-houses require that two-thirds shall be summer and one-third winter oil. Two gallons of summer oil, at 86.6 cents per gallon, with one of winter oil, at 101.6 cents, will form a mixture worth 91.6 cents per gallon; and two gallons of spring oil, at 90 cents, with one of winter, at 93 cents, as actually paid during the past autumn, make the average cost 91 cents. In 1841, the average cost of oil was 98.2 cents per gallon.* Our calculations of relative economy will therefore be based for the Atlantic on the minimum market prices, viz:

Lard, 5.8 cents per pound; oil, 91.6 cents per gallon; rosin, 65.8 cents per barrel.

For the Lake country we may assume the Cincinnati prices, viz:

Lard, 4.75 cents per pound; oil, $1.25 per gallon; rosin, $1.50 per barrel.

The gas coke used at the Christiana light-house costs 6½ cents per bushel, and the wood we assume to cost $3 per cord.

As we have seen 486 feet of cubic gas made from seventy pounds of rosin, with 2½ bushels of coke and one-twelfth of a cord of wood, and as we have found 162.4 cubic feet of gas sufficient to serve the 5 burners an average night of 12 hours, it appears that the materials for making gas for one night will cost 18.66 cents, of which the rosin alone costs 5.1296 cents. The interest on the cost of the gas apparatus and gas-house (estimated at $1,500) is, for one day, 24.6 cents. The annual repairs of building and apparatus, except retort, we estimate at $100, or 27.5 cents per night.

From the experience of other establishments using rosin gas, we estimate that the renewal and resetting of retorts alone will cost $50 per annum, or 13.7 cents per night; and other repairs, such as grate bars and soapstone, for defending the retort, $15 per annum, or 4.11 cents per night. As the reflectors will cost the same, whatever species of light is used, and the gas burners and glass tubes or chimneys will cost about the same probably as the lamps and corresponding appendages for lard or for oil,† the five items just given may be taken to constitute the nightly expense of gas, viz: 88.47 cents.

The comparison of lights in the 6th and 7th experiments above given, when the gas was of medium quality, proved that 5 gas burners are equal 5.4973 = 10.01 oil lamps. Hence, to furnish the same quantity of light from oil which is now given by the gas, will take 10 01 x .009267 x 12 = 1.113 gallons of oil, which, at 91.6 cents per gallon, will cost 101.95 cents.

By the same comparative experiments, the number of lard lamps equal in power to 5 gas burners is \( \frac{5}{3.45} = 1.43 \). Each of these burning .1356 of a pound of lard per hour, the whole would in 12 hours consume 5.602 pounds, which, at 5.8 cents per pound, will cost 32.49 cents per night for the light-house.

* See report of Committee on Commerce, 1842, pages 40, 41.
† Glass tubes for oil and lard lamps are broken in handling; those for the gas burners by the sudden heat to which they are exposed in lighting the gas from the top; but the balance is judged to be, on the whole, favorable to the gas. As above stated, the mirrors undergo less deterioration from gas than from the smoke of lard or oil.
Hence we have for a given amount of light on the Atlantic and Gulf of Mexico the following comparative table of the expenses of the several materials:

<table>
<thead>
<tr>
<th>Material from which light is obtained.</th>
<th>Number of burners to give the light used at Christiana lighthouse.</th>
<th>Cost, in cents, per night.</th>
<th>Cost, in dollars, per annum.</th>
<th>Relative cost, that of oil being 100.</th>
<th>Cost, per annum, for the light, furnished by 2,671 oil lamps, burning at the rate of that of lamp, as per preceding table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lard</td>
<td>3.45</td>
<td>32.49</td>
<td>118.59</td>
<td>31.9</td>
<td>$31,643</td>
</tr>
<tr>
<td>Rosin gas</td>
<td>5.00</td>
<td>88.47</td>
<td>322.91</td>
<td>86.8</td>
<td>$86,163</td>
</tr>
<tr>
<td>Oil</td>
<td>10.01</td>
<td>101.95</td>
<td>372.12</td>
<td>100</td>
<td>99,292</td>
</tr>
</tbody>
</table>

The last column is computed from the number of lamps actually in use in the light-house establishment in 1842. (See "light-houses, beacons, and floating lights.")

At the Cincinnati prices of the several materials, admitting wood and coke to cost the same as above, the table will exhibit very considerable differences between lard and gas or oil. The resin for a night's burning of gas would cost 11.691 cents, coke and wood 13.53 cents; and all the other expenses of the establishment being supposed the same as above, the cost per night for gas comes to 27.4 + 25.22 + 24.60 + 13.70 + 4.11 = 95.08 cents. At $1.25 per gallon, the oil per night would amount to $1.113 \times 125 = 139.12 cents; while at 4.75 cents per pound, the lard would cost 5.602 \times 4.75 = 26.61 cents per night.

Table of the cost of light from lard, gas, and oil, at Cincinnati prices.

<table>
<thead>
<tr>
<th>Material.</th>
<th>Number of burners.</th>
<th>Cost, in cents, per night.</th>
<th>Cost, in dollars, per annum.</th>
<th>Relative cost, that of oil being 100.</th>
<th>Cost, per annum, at prices on the preceding table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lard</td>
<td>3.45</td>
<td>26.61</td>
<td>97.13</td>
<td>19.13</td>
<td>$25,916</td>
</tr>
<tr>
<td>Rosin gas</td>
<td>5.00</td>
<td>95.03</td>
<td>346.86</td>
<td>68.31</td>
<td>92,553</td>
</tr>
<tr>
<td>Oil</td>
<td>10.01</td>
<td>139.12</td>
<td>507.79</td>
<td>100.00</td>
<td>135,493</td>
</tr>
</tbody>
</table>

Hence it appears that, at Cincinnati prices of rosin and oil, the relative cost of gas light and oil light is greatly more in favor of the former than on the Atlantic border. We are not informed as to the price paid by Government for oil on the lakes. It is probably less than the minimum quotation which we were able to find for oil at Cincinnati,
and which, it will be seen, is only for winter-strained oil. From the
great extension given of late to the use of oil in manufactures, for ma-
chinery and on railroads, in this and many other countries, we do not
conceive it probable that a material reduction is likely soon to take
place in the price of that article, especially as there appears to be an
actual falling off in its importation for the present year, with an im-
pression among dealers that the deficiency will continue. There is,
besides, one consideration not to be lost sight of in estimating the econo-
my, in the different kinds of light. It relates to the possible future con-
dition of the country, and the influence of that condition on the supply
of the respective materials. In the case of war, should commerce become
crippled, and the whale fisheries suspended, the price of oil must of nec-
essity advance, while lard and rosin, being obtained almost exclusively
from our own soil, would remain nearly as at present, or perhaps decline
in price, for want of a foreign market. In such an event, we could
hardly expect sperm oil to cost less, even on the Atlantic, than it now
does at Cincinnati.

It is possible that our estimate for the renewal of retorts may in prac-
tice be found less than the actual expenditure. We have taken for this
item the result of experience at the Wilmington rosin gas works. There,
agreeably to the information which you had the goodness to procure, the
average duration of retorts is one year, gas being made from two to three
times a week,* (rather oftener than at the light-house,) and the retorts
cooled after each making. It is to be remarked that the retort, or that
part of it which requires to be renewed, is a single iron casting, weighing
but five or six hundred pounds; and that, as all the retorts which might
be required would be taken from the same pattern, they would be obtained
at the lowest rates charged for similar work.

In the larger light-houses, such as those at Baker's island, Nauset
beach, Sandy Hook, the Navesink, Cape Henlopen, North Point, Cape
Henry, and those at the Northeast and Southwest Passes of the Missis-
sippi, stations at which, either in one or more houses, the power of from
eighteen to thirty oil lamps is employed, the relative economy of gas
would be decidedly greater than at the small establishment at the mouth
of the Christiana. This advantage arises from the fact, that the first
cost of an apparatus and gas-house, and the annual cost for repairs,
would remain nearly the same for the larger as for the smaller light;
and the cost of materials and retorts only would increase with the quan-
tity of gas to be supplied. These latter items are less than one-half of
the total expense. Thus, on the Atlantic, materials and waste of retorts
cost 36.47 cents per night, while interest on cost of apparatus and house,
and the annual allowance for repairs, cost 52 cents per night. Admitting
the latter number to be increased ten per cent, for the larger establish-
ment, and the cost of materials and retorts tripled where a 30-lamp
power is required, as at Navesink and the mouths of the Mississippi, the
nightly expense of gas would be 166.6 cents, that of oil 305.85 cents;
or the relative cost of gas would be only 54.5 per cent. of that of oil.
Admitting the renewal of retorts, grate bars, and soapstone, to cost even

* At the New York rosin-gas works, the retorts, which are constantly in use, last from
five to eight months.
double as much per annum as we have estimated, there will be an economy of only four per cent. in favor of oil for a 10-lamp light-house while for a 30-lamp house it would be nearly 30 per cent. still in favor of gas. Should a more substantial building, and particularly a fire-proof structure, for the gas-house, be employed, in order to insure that great element of value in a light-house, certainty of action, the first cost would be considerably enhanced, but the annual repairs greatly diminished. The next point of inquiry is relative to the novelty of the mode of generating gas at the Christiana light-house: "Whether the mode of generating the gas is an improvement, or whether it is made upon the principle generally adopted."

To this we would reply, that to make gas out of rosin, to aid the solution of this material, and to economize it by returning a part or the whole of the tar to the receptacle, is certainly no novelty. To fill the retort with fragments of coke, in order to give activity to the decomposition of the rosin, is a well-known practice. To pass the gas through a condenser, formed of upright tubes, is equally common. Some rosin gas works have used but a single upright tube of this kind, while at coal-gas works very many more than Mr. Coston has applied are usually employed. The only points in which the apparatus for making gas appeared to vary from those elsewhere adopted are: the delivery of the rosin to the retort, near its hottest part, by means of the vertical branch; the peculiar form of the feeding apparatus at the upper end of this tube; * and the copper jacket surrounding the neck of the retort, and filled with water, kept circulating by the heat which it receives, and thus keeping the neck of the retort cool, and preventing the drying on of the tar, which would, if not thus prevented, soon clog the neck.

This plan of keeping surfaces cool by surrounding them with a case, through which water is made to circulate, is not in itself new—whether it has elsewhere been applied to the necks of gas retorts, we would not positively decide.† The feeding of the rosin by a large vertical tube, having a smaller one concentric with it, and placing the same in the hot part of the furnace, instead of feeding through a syphon altogether outside of the furnace, as is the practice in some other rosin-gas works, has probably the advantage of yielding rather less tar than would otherwise be obtained. The species of tar seal used by Mr. Coston, and placed immediately above the tube of supply, keeps the melted rosin very hot, and obviates choking in the supply pipe. Beyond this, we are not aware of its being superior to the syphon used in other rosin-gas works.

We refer to a communication appended to this report for the reasons assigned by Mr. Coston for declining to furnish any statements or drawing relative to the construction or novelty of his apparatus.

In reference to the two remaining topics presented in Mr. Pleasonton's letter, (viz: the explosive nature of gas, and the incompetency of "keepers, ignorant of all the properties of gas," to manage light-houses in which it should be adopted,) we need say but little.

---

* We are apprized that this substitute for the syphon has long been used at the Philadelphia gas works.
† It is believed to have been so applied at the rosin-gas works in Boston.
The gas used for illuminating purposes is not by itself explosive. It requires a very considerable intermixture of oxygen, atmospheric air, or other gaseous matter capable of combining with its elements, to render it explosive. Such an admixture it cannot receive while it remains in the gasometer, subjected to the pressure under which it is forced out and driven through the burners. The very rare instances in which illuminating gas has been the cause of an explosion have happened by its escaping into some close apartment, becoming mixed with atmospheric air, and exploded on the approach of a light. If other reasons, therefore, urge the adoption of gas, we do not conceive that the very remote probability of an explosion, which would only happen through the most culpable negligence, ought to present the least impediment to its employment, any more than the existence of the same, or rather the vastly greater, probability of the explosion of a steam boiler ought to preclude from navigation, from railroads, and from manufacturing establishments, that most important of modern agents. We do most certainly not recommend that a keeper, "ignorant of the properties of gas," be placed in charge of any light-house in which that material is to be used. Nor do we conceive that so indiscreet a procedure is either necessary or probable. The knowledge of the properties of gas, and of all that relates to its production and application, is now so generally diffused, that the Government can easily command the services of keepers competent to manage such an establishment. It would naturally suggest itself to any one who should be charged with the introduction of gas into our light-houses, to commence with those which are conveniently situated for commanding the necessary intelligence and skill to construct and manage the works, and to proceed in that gradual and cautious manner which would insure the efficacy of every arrangement and the competency of every keeper intrusted with its management.

In order to enable us the more fully to answer several of the above inquiries, we addressed to the general superintendent of light-houses in the United States a request to be furnished with some documents relative to the establishment, which he obligingly furnished, accompanying them by some remarks, which we annex by way of appendix to this report.

Other communications, already referred to, we likewise subjoin.

WALTER R. JOHNSON.
JOHN C. CRESSON.
GEORGE W. SMITH.

PHILADELPHIA, December 16, 1844.

APPENDIX.

TREASURY DEPARTMENT,
Fifth Auditor’s Office, November 29, 1844.

SIR: I had the honor this morning to receive your letter of the 27th instant, requesting to be furnished with copies of such reports as may have been made from time to time, relative to the Light-house Establishment.
These reports altogether are very voluminous, and of some of them I have run out of copies. Had you stated the precise information you wished to obtain, I should probably have been able to select the report containing it.

As the report of the Committee on Commerce of the House of RepresentatIVES, made in May, 1842, contains very full information on the subject of our lights, as well as those of England and France, I have thought proper to enclose a copy of that, with a list of our light-houses, number of lamps, &c., from which I presume you will be able to gather the information you wish. Should you wish to make a comparison of the expense of oil and gas, it may be stated that our lamps consume on an average of oil about 30 gallons per lamp annually. The cost of the oil varies considerably. In the spring of 1843, we obtained spring oil at 51 cents and winter at 58 cents, while we have been obliged to pay, for the present year's supply, in the spring, from 78 to 85 cents, and the fall 90 and 93 cents per gallon.

Should you desire any further information, it will afford me pleasure to furnish it, on your signifying a wish to that effect.

I have the honor to be, respectfully, sir, your obedient servant,

S. PLEASONTON.

----------

Letter from W. R. Johnson to S. Pleasonton, Esq.

PHILADELPHIA, November 30, 1844.

SIR: I have pleasure in thanking you for copies of your tabular statement of the light-houses, beacons, and floating lights of the United States, and of the report of the Committee on Commerce on the Light-house Establishment, which you had the goodness to forward, accompanied by your esteemed favor of yesterday.

Should it be in your power to send a copy of Governor Davis's report, (Senate document, 1st session 26th Congress, No. 474,) it would be an acceptable and useful addition to those already received. There is one other means of information of which we wish to avail ourselves before deciding the general questions submitted to us in relation to the fitness or unfitness of gas for our light-houses, its economy in comparison with other kinds of light, &c., and that is, an opportunity of inspecting the dioptric or lenticular light at the Navesink station. Should you think proper to defray, or allow Mr. Naudain to defray, the expenses of a visit to that place, it is probable that one or more of the committee might spare the time to make an inspection. An order to the proper superintendent and to the keeper would no doubt facilitate and expedite the objects of such a visit.

I am, very respectfully, your obedient servant,

WALTER R. JOHNSON.

S. PLEASONTON, Esq.
From S. Pleasanton to Walter R. Johnson, Esq.

Treasury Department,
Fifth Auditor's Office, December 2, 1844.

Sir: I received this morning your letter of the 30th ultimo. Agreeably to your request, I enclose a copy of Governor Davis's report upon lenticular light-houses, made in May, 1840, (No. 474, Senate document,) and having but two copies, I must request the favor of you to return it after perusal. That document, however, is of little value, as it is founded chiefly upon a comparative statement of Mr. Lepaute, the manufacturer of the lenses, who overrated the consumption of oil in our light-houses, and underrated that of the lenses. As a proof that Mr. Lepaute had underrated the consumption of oil by the lens lamps, I also enclose a report made by me to Congress in July, 1842, accompanied by a communication of Mr. Fresnel, who is charged with the management of all the light-houses in France, and who states, from actual knowledge, the consumption of the different orders of lenses. Besides this information, the report contains much more that you will find interesting.

This information, with my remarks concerning lens lights contained in the report of the Committee on Commerce, at page 28, now in your possession, will give you pretty full and accurate information in relation to the utility and cost of lens lights.

Should the board of examiners not be satisfied with the information contained in these papers, I should be willing to defray the expenses of one of the number to the Navesink lights, for the purpose of inspecting them; though I am apprehensive, as the keeper is a new one, that he would not be able to give them any information of much value. I should be pleased to hear from you again on the subject.

I have the honor to be, respectfully, sir, your obedient servant,

S. PLEASONTON.

Walter R. Johnson, Esq., Philadelphia.

Walter R. Johnson to Arnold Naudain, Esq.

Philadelphia, November 28, 1844.

Dear Sir: In order to complete our computation of the relative cost of different kinds of light, we find it necessary to obtain information on two or three points not found on our minutes.

1. What has been the cost of Mr. Coston's apparatus (except the building) as now used, and independent of the alterations made while experimenting on the subject?

2. What is the cost of the gas-house, separately?

3. How long has the retort now in use been regularly employed; what is its weight without the lid; and what its cost, including the setting?

4. When was gas first employed as a full substitute for oil? What interruptions, if any, have occurred in its use; for how long periods, and how have they been caused?
One or two queries which we desired to submit to the superintendent of the Wilmington gas works we should be glad to have answered, particularly as to the length of time the retorts are found to last, how much of the time they are in use, and how often they are cooled off.

I am, very respectfully, your obedient servant,

WALTER R. JOHNSON.

ARNOLD NAUDAIN, Esq.

Arnold Naudain, Esq., to Walter R. Johnson.

Collector's Office,
Wilmington, Delaware, December 2, 1844.

SIR: Your letter of the 28th ultimo, relating to the gas establishment at Christiana light-house, came to hand on the 29th. I was not originally charged with the disbursements for the gas improvements at Christiana light house. The late Secretary of the Treasury devolved the care of its construction wholly upon Mr. Coston; and until the bills of expense incident to the prosecution and completion of the work were rendered and approved, I had but little control over the matter.

The items in the bills rendered for materials for the house, and for the apparatus and fixtures, as well as for the experiments made in the progress of the work, are all blended together. The same difficulty occurs in which labor is charged. Hence the difficulty in giving definite answers to your several queries.

You will therefore perceive that the most that I can do will be to make a near approximation to the truth. The following statement is therefore respectfully submitted: In reply to your first query, "what has been the cost of Mr. Coston's apparatus, as now used?" I think I may set it down as ranging between twelve and thirteen hundred dollars.

To your second query, "what was the cost of the gas-house, separately?" I answer, about $600.

Your third query asks, "How long has the retort now in use been regularly employed? what is its weight, exclusive of the lid; and what its cost, including its setting?" I answer, that the retort now in use is of cast iron, and has been used continually since the first of July last, with the exception of 18 nights' supply of gas, when the first chimney was taken down, and another substituted, to secure the buildings better against fire. The weight of the retort without the lid, as near as I can tell, is about 500 pounds; and the cost of the whole retort, fixtures, and setting, per bill, is $139 09.

Fourth query: "When was gas first employed as a full substitute for oil; what interruptions, if any, have occurred in its use; for how long periods, and how have they been caused?" Gas was first employed as a substitute for oil about the 1st of May last, and has experienced no interruption, save the one of 18 days in taking down the chimney.

The queries you desired to have submitted to the superintendent of
the Wilmington gas works I attended to, and am enabled to state their retorts are found to last about twelve months; that they make gas three times a week in winter, and not quite so often in summer, and cool off the retort about as often as they make gas.

I am, very respectfully, your obedient servant,

ARNOLD NAUDAIN, Esq., Collector,
Per JACOB B. VANDEVER, Deputy Collector.


From Walter R. Johnson to Arnold Naudain, Esq.

PHILADELPHIA, December 3, 1844.

DEAR SIR: I am in receipt of your communication of yesterday, for which please accept my thanks.

I suppose the twelve or thirteen hundred dollars for the apparatus to be exclusive of the building, as I believe I expressed a desire to have it so estimated. This, with $600 for the latter, brings the total cost of putting up another establishment of the same kind to eighteen or nineteen hundred dollars. I also presume that the cost of the retort included that of making the pattern—an expense which would not have to be incurred in renewing it, or in preparing for another apparatus elsewhere. Am I right in both these points?

I suspect, also, that the cost of the retort embraces that of the cup on the top of the vertical arm, and which serves to admit the rosin. Unless this be the case, I am at a loss to understand how a casting weighing but 500 pounds could have cost $139 09, or 27.8 cents per pound, even including the setting.

Yours, very respectfully,

WALTER R. JOHNSON.

Arnold Naudain, Esq.

Arnold Naudain, Esq., to Walter R. Johnson.

CUSTOM-HOUSE, WILMINGTON, December 4, 1844.

DEAR SIR: You have construed Mr. Vandeever's letter correctly. The apparatus cost about $1,200 or $1,300, and the house about $600.

The charge of $139 09 includes about 870 pounds of castings, at four cents per pound; the cost of a pattern for retort, $21; and the cost of workmanship in fitting it up with the cup on the vertical arm, to admit the rosin, as well as about $9 for cast-iron weights, &c., for the counterpoise of gasometer. The bill, however, does not give the weight of the retort separately, with or without the lid, and 500 pounds was an estimate of the weight of the retort alone. The sum paid for fitting up the retort and setting it up at the light-house, independent of the cost of castings or pattern, was $38 41; which, together with the cost of the castings, would be the expense of the retort, say from $60 to $65. The bills rendered
do not distinguish the precise part of the apparatus for which the expense was incurred; and I believe the same bill includes the cost of the copper covering of the gas pipe and its connections with the cistern, amounting to about $15. This is the nearest approximation I can make to the cost of the retort alone, from a careful examination of the bill in which it is included. The experiment at our light-house was made under unfavorable circumstances. The work was done in winter, when the days were short, and work frequently interrupted on account of the weather. Several retorts were used, I believe two cast iron and one wrought iron, before the present one was made. There was building up and pulling down again, and rebuilding, all of which might now be avoided, with the help of our present experience; and I believe that another gas-house and apparatus, with fixtures, might be built for $1,200 to $1,500, of the size and efficiency of the Christiana works.

Yours, most respectfully,

ARNOLD NAUDAIN, Collector.

WALTER R. JOHNSON, Philadelphia.

Walter R. Johnson to Benjamin F. Coston.

PHILADELPHIA, December 2, 1844.

SIR: As we are now preparing the report on the Wilmington light-house, we should be glad to have, as early as may be convenient, the drawings of your apparatus, which you proposed to furnish, as well as the description of such parts as you consider to be original with yourself. Should you think proper to add the specifications of any parts modified from those which we have examined, it would, perhaps, be expedient that they should be described and figured separately.

Yours, very respectfully,

WALTER R. JOHNSON.

Mr. Benjamin F. Coston.

Mr: Coston to Messrs. Johnson, Cresson, and Smith.

NAVY YARD, WASHINGTON, December 4, 1844.

GENTLEMEN: As to so much of the instructions of the Fifth Auditor to you as relates to the amount of originality in my plan, I beg leave to say, that I deem it irrelevant to all the requisite objects of investigation, and beg leave respectfully to decline an answer. My chief object in declining to answer is, that I am now preparing to take out a patent, and it might operate prejudicially to my interests by the publication of the facts in your report. This, I hope you will see, is a precaution warranted by the circumstances of the case.

Very respectfully, your obedient servant,

BENJAMIN F. COSTON.

Professors Johnson, Cresson, and Smith.
SIR: In support of the suggestion offered in the report on the Christiana light, of the applicability of gas consumed in Bude burners to the lenticular lights at the Navesink, I beg leave to present a few citations from a report of a select committee of the British House of Commons, a copy of which you have been so kind as to place in my hands. They show, first, that the burning of oil in mechanical lamps with concentric wicks is less economical than in ordinary Argand lamps; and, secondly, that burning gas in Bude burners is more economical than in common Argand gas burners. On the latter point, I may state that recent experiments, made in Philadelphia, are understood to confirm essentially those formerly made in London.

Extracts from the report of the Select Committee on Lighting the House.

MAY 20, 1842.

Mr. Gurney testifies: "From the concentric wick oil lamp tried at the Trinity House, they only obtained light equal to that of 9 Argand lamps, by consuming oil equal to 17 such lamps, so that light from the concentric oil Argand is nearly double the expense of the ordinary light from Argand burners."—Page 17.

Dr. Andrew Ure says: "I know of no process by which a given quantity of light for a large apartment can be produced equal to that obtained from Mr. Gurney's atmospheric Bude burner, unless at double the expense.

"I compared a Bude light in the office (No. 6 Waterloo Place) very carefully with a common Argand burner, and I found from these experiments that Mr. Gurney's burner gave at least double the light with the same consumption of gas as was obtained from a common Argand burner."—Page 24.

Professor Charles Wheatstone states, that he "tried the atmospheric Bude light with the common Argand gas burner. The Bude light consumed not quite four times as much gas as the Argand burner, whilst the light given by it was six and a half times as great. For every unit of light the Bude consumed 525.6 cubic inches of gas per hour, and the Argand gas burner 900 cubic inches per hour," (showing the economical advantage of the Bude over the Argand light to be as 100 to 58.4.)

"The Waterloo Place Bude light was found equal in power to from 44 to 47 of the ordinary street lights used in that neighborhood."—Page 25.

Mr. William Keene testifies as follows: "I have kept a register for 17 days, and found the Waterloo Bude light to consume 62.8 cubic feet per hour, and assisted Professor Wheatstone in proving that it was equal to 45 street burners. Each of the street lamps should consume five cubic feet of gas per hour." "There will be double the light produced by burning 50 feet of gas per hour in a Bude burner, to what is obtained by consuming that quantity of gas in ordinary Argand burners."—Page 26.

Dr. Neil Arnot says: "I made experiments on Mr. Gurney's new light, and on the Argand gas burner. The result was, that the larger
burner burnt five times as much gas, and gave eight times as much light, as the smaller or Argand."

I may remark, in conclusion, that some of the above comparisons appear to have been made on the smaller sizes of Bude burners; in which case, the advantage would of course be found rather less than where four or five concentric rings are employed.

I am, very respectfully, your obedient servant,

WALTER R. JOHNSON.

Stephen Pleasonton, Esq.

---

Report of the Secretary of the Treasury, on improvements in the light-house system and collateral aids to navigation.

August 5, 1846.—Read, and ordered to be printed.

Treasury Department. August 5, 1846.

Sir: I have the honor to submit to the Senate of the United States a report in relation to improvements in the light-house system of the United States, and in collateral aids to navigation.

The improvement of our system of light-houses has attracted at different times the attention of Congress and of the Executive. Impressed with the necessity for obtaining full information in regard to the improvements alleged to have been made in Europe, emanating principally from France, I applied in June last to the Navy Department for the detail of two officers, who might, under instructions from this Department, visit the countries into which the improved system had been introduced, make themselves practically acquainted with the different parts, and establish the necessary comparison with our own. Lieutenants Thornton A. Jenkins and Richard Bache were detailed for this service, and visited some of the principal lights on the shores of the Baltic and North seas, the coast of England, Ireland, and Scotland, and the establishments for the construction of the new lighting apparatus in France; collecting, with care, zeal, and intelligence, the full and varied information upon this important subject, and others connected with it, which is so ably presented in their report to this Department.

The subjects are systematically treated in their report, and it will be necessary merely to refer here to suggestions for the improvement of our system, which meet my hearty concurrence.

In countries where the system of lighting is good, a general plan for the classification of lights, selection of sites, construction of the light-houses and apparatus, and inspection, has been adopted, or improvements have been slowly introduced, under the directions of existing authorities. The most perfect system in Europe is the result of the former plan; and it must be obvious, that, for a growing country like ours, no other can secure, on the greater part of the coast, a due attention to the wants of commerce and navigation.
The unequal distribution of lights upon different important parts of our coast proves this, and shows how desirable it is that some general plan should be fallen upon, by which the claims of different parts of the country might be duly considered, a light provided wherever it is desirable to navigation, and expenditure saved when no such necessity exists; that, when a light-house was decided to be necessary, the site of the buildings should be properly selected, the buildings properly constructed, so as to combine stability and economy; all the accessories, as store-houses for oil and for lighting apparatus, for fuel, and the like, properly arranged; that the lighting apparatus should be of the most approved kind and construction, and so placed as to illuminate the required parts of the horizon without waste; that the lights should be duly classified, so that, from the large sea-coast light to the small harbor light, the buildings, lighting apparatus, and accessories, might be on the proper scale; the distinctive character for the lights adopted, which experience has shown most effective, as fixed, revolving, fixed lights with flashes, successions of bright light and eclipses at regular intervals, and lights of particular colors; that when ready for illumination, the lighting apparatus may be properly kept and attended to, under effective inspection.

It is not possible to leave such things as those to local information, derived at second hand, or to chances, without paying dearly in the end for the want of system.

In all these points it appears that other countries have advanced rapidly; and it becomes us to see what improvements, introduced elsewhere, are adapted to our use, and to ascertain how our general system may be modified.

A comparison of the lighting apparatus in use with us, and of the improved apparatus of France, shows that in this essential our progress has not been as great as might have been desired.

The reports of the inspecting officers detailed from the Navy to examine the lights on our coast showed their absolute defects; the present report shows their deficiencies relative to those of other countries. The trial made of one of the French lights, at the entrance to New York harbor, at Sandy Hook, has been very successful, but the use of this apparatus has not been extended. A light-house need be seen from particular parts of the horizon only; and as the lamps used throw off their lights almost equally on all sides, the directions of portions of the rays must be changed. This may be done by reflection from opaque substances, as from metallic mirrors; or by bending or refraction, by transparent bodies, as by glass prisms or lenses. Much more light is lost by the use of the most highly-polished surfaces, as reflectors, than by passing through transparent bodies; and hence lenses are more useful and economical for light-house purposes than mirrors. The refracting or lens apparatus, invented in France by Augustin Fresnel, has been generally applied under the direction of his brother, Leonor Fresnel, the present accomplished secretary of the board of light-houses.

In this apparatus, lenses of glass are used to throw the light of powerful lamps in the required directions upon the horizon, and the part which would otherwise escape upwards is reflected to the horizon by glass prisms, so placed that the rays fall upon the back or second surfaces of the
prisms, at angles at which they are entirely reflected. The lenses are built up of separate pieces of glass, thereby saving the weight and cost of large masses of material, besides diminishing the thickness, and thus preventing the loss of light by absorption, and permitting the figure of the surface to be adjusted so as to bring the rays accurately to a focus. If the lens apparatus be made to revolve, the navigator will see brilliant flashes of light, gradually growing dim, and succeeded by short intervals of comparative darkness; and if a second set of lenses, suitably arranged, revolve about the first, which remains fixed, a general illumination will be varied by brilliant flashes—these may be white or colored; and thus the appearance of lights may be so varied as to make them distinctive. A single large lamp, supplied with oil by mechanism, (as in French light-houses,) or by hydrostatic pressure, (as in some of the English ones,) is used with the lens system, and produces great economy in the consumption of oil necessary to supply a given quantity of light.

The dimensions of the apparatus are easily varied to suit the different quantities of light required, from the small harbor light to the large seacoast light. In the French system, the lights are divided into four orders, the first being the most powerful; and each order may be subdivided into a larger or smaller size. The best reflecting lights do not more than reach, in power, the second order of the lens system.

The advantages of the Fresnel or lens system are: 1st, in the greater brilliancy of the light; 2d, in the greater quantity of the more brilliant light thrown upon the horizon; and, 3d, in the less consumption of oil in obtaining these advantages. Simple experiments and calculations based upon them give an unerring means of ascertaining the relative brilliancy, quantity, and economy of different lights. If two lights are equally bright, they will illuminate equally two equal surfaces placed at the same distance from them. If one is brighter than the other, the brighter will illuminate equally the same surface when farther from the light; a fourfold brightness corresponding to a double distance, a ninefold brightness to a triple distance, and so on. Thus it is easy to compare the relative brilliancy of lamps, and, adopting the light of some particular lamp as the standard, to describe other lights as equivalent in brilliancy to once, twice, or more times, the standard.

The useful effect of a light depends not only on its brilliancy, but on the extent of horizon which it can illuminate. The average brilliancy in different directions, multiplied by the extent of horizon over which it shines, gives its useful effect. Its economy is measured by this useful effect directly and inversely by the consumption of oil required to obtain it.

The careful experiments of Mr. Fresnel leave no doubt of the great advantages in respect to brilliancy, useful effect, and economy of the lens system, as may be seen by a few examples.

A harbor light on the lens system, of the smaller size of the fourth order, with a single mechanical lamp burning 1 3\(\frac{1}{4}\)th ounce avoidupois of oil per hour, would give twice as brilliant a light as the ordinary reflecting system, having a lamp burning 1 2 ounce avoidupois of oil per hour. The quantity of light on the horizon would be double, the cost of a given quantity of light one-half, and therefore the economy twofold.
As the apparatus increases in size from this to the higher orders, the advantage of the lens system increases. In the third order, second size, a mechanical lamp with a double wick, burning 6¾ ounces avoirdupois of oil per hour, gives as much light as fourteen lamps with reflectors, each burning 1¾ ounce avoirdupois of oil per hour. The useful effect is once and a half times, and the economy between three and fourfold. In the second order of lights the new system for equal useful effects is three times as economical as the old, reaching in the larger sizes to fourfold. A power equivalent to that of the first order of lens lights has not been reached by the reflecting system.

The cost of the erection of buildings for the new system of lighting, and the first cost of the apparatus itself, is somewhat more considerable, and the number of keepers required is greater than with the old; the repairs, on the contrary, are much less. An accurate comparison of these particulars shows that in France the economy is in favor of the new system. Thus, taking into consideration the interest on the cost of tower, lantern, reflectors, or lenses, and of keeping up the light, the relative expense of the two plans for a small harbor light is as 236 to the new, to 226 of the old plan; while the quantity of light on the horizon is as 2 to 1 in favor of the new; and hence the economical effect is nearly double upon the new system. For a large revolving light (second order) the annual outlay for the old and new systems would be as 126 to 208, while the useful effect would be only as 1 to 2, and the economical effect of the new system would be more than once and a half that of the old. The cost for the lens apparatus might for the present be greater in our country; but the economy in lighting by the lens system is too great for this circumstance to turn the balance against it.

The mechanical lamp, used with these lights, or some other which American ingenuity may supply, or the hydrostatic or pneumatic lamp in use in the English light-houses, will replace with advantage the present imperfect lamp. In France, the mechanical lamp is found to require but small repairs, readily made in establishments where the lamps are constructed; and both construction and repairs would surely be practicable here. The cost of repairs of the lens apparatus is in a series of years merely nominal, and experience has shown that it is more secure and more easily seen than the old. No important sea-coast lights should be left without being watched by a keeper and, in the economy in lighting, will much more than pay the cost of two keepers in the larger light-houses.

Whether the rape-seed oil generally used in the French light-houses may be employed in our own with advantage, is a question which cannot now be settled; it may, however, be desirable to call the attention of farmers to the cultivation of the plant from which it is obtained.

The use of the screw-pile for the foundation of light-houses has, by rendering the establishment of permanent structures upon banks and shoals comparatively easy, safe, and economical, superseded in many cases the use of light-boats, which, especially in exposed positions, are of comparatively little value.

The buoys used in the entrances to our harbors are now placed by local authorities, and under loose regulations. A general system should
be adopted of coloring and numbering, and should be so rigidly adhered to that the seaman would know his position as soon as he discovered a buoy. This is practicable, as will be seen from the interesting account, in the report of Lieutenants Jenkins and Bache, of the intricate approaches to the port of Liverpool, which are rendered quite safe by the system of buoys, lights, marks, and tide signals. The natural marks which disappear yearly from our coast should be replaced by permanent ones; screw-piles for mooring buoys should in certain cases be supplied. The arrangements for placing buoys and verifying their positions require to be rendered systematic, and to be subjected to some general control. The navigator should have due notice of all changes from a source connected with the whole light-house system.

The best modes of lighting would be ineffective, unless the keepers were careful and intelligent persons, and instructed in the necessary particulars of the business. Some training is desirable. Frequent reports, and perhaps the suggestion in regard to keeping meteorological and tide registers, as a means of securing attention and intelligence, may be adopted.

From the numerous details here glanced at, and fully discussed in the report of Lieutenants Jenkins and Bache, and in the documents appended to it, it is obvious that a very considerable range of practical and theoretical knowledge is required for the improvement of the system; more than can be looked for from one individual, however eminent in science. The proper organization of the system, and planning of its details, require the efficient head of a bureau familiar with the working of a general organization—a person capable of furnishing information in regard to the coast and harbors from actual surveys; persons minutely acquainted with the wants of navigation, with the details of location and construction of the light-houses, and with the chemical and mechanical principles involved in lighting. While this knowledge cannot be obtained from one person, a board may be organized, without expense to the Government, by which the system may be considered in all its particulars, and an efficient plan of action recommended. Such a board might consist of the Fifth Auditor, the Superintendent of the Coast Survey, two naval officers, two engineer officers, (one military, the other a topographical engineer,) and a secretary, who might be a junior officer of the Navy. By their action a plan might be prepared which would secure approval, and provide for the necessary progress of our system of light-houses, and aids to navigation connected with them. I would, in conclusion, respectfully request from Congress the authority to organize such a board, and to execute the plans which they may suggest, as far as practicable under existing laws regulating this branch of the public service.

Very respectfully, your obedient servant,

R. J. WALKER,
Secretary of the Treasury.

Hon. GEORGE M. DALLAS,
Vice-President of the United States, and
President of the Senate.
DIRECTIONS.

TREASURY DEPARTMENT, June 19, 1845.

GENTLEMEN: The Secretary of the Navy having detailed you for special duty connected with light-houses, to report to the Treasury Department, you are hereby directed to make the examinations pointed out in the annexed instructions, and to report to me, jointly, the results, as soon as practicable.

You will keep an account of the actual expenses which may be incurred by you in execution of your instructions, as well travelling expenses as those for drawings and books, for obtaining necessary information, and any other proper expenses incurred on account of your mission, which will be paid on accounts to be submitted through this Department to the Fifth Auditor of the Treasury. A reasonable advance will be made to you on account of these expenditures.

The materials which you may collect will be deposited in the Treasury Department when your report is presented. The Department desires that your examination should be thorough; that you should be economical in expenditure, and yet not so sparing as to impair the efficiency of your work. The points to which you go should be as few as consistent with obtaining full information in regard to matters referred to in your instructions; and yet you should omit no place where it is probable, from the best information you can procure, the results of an examination will be important.

You will be provided with letters from the Secretary of State to the diplomatic and consular agents of the United States, in Great Britain, France, and Belgium especially, and a general letter, to serve in case you find it necessary to visit other countries.

You will report to this Department by letter once in three months, stating the places which you have visited, and giving a very general view of your progress. On your return to the United States, after first examining some of our principal light-houses, you will report in person to me.

I am, gentlemen, very respectfully, your obedient servant,

R. J. WALKER,
Secretary of the Treasury.

To Lieut. Thornton A. Jenkins, U. S. N.
Lieut. Richard Bache, U. S. N.

INSTRUCTIONS.

TREASURY DEPARTMENT, June 19, 1845.

GENTLEMEN: This Department desires to procure information which may tend to the improvement of the light-house system of the United States; and as it is alleged that important improvements have been made in the light-houses of Europe, especially in those of France and Great Britain, the department wishes to understand fully what these improvements are, and if they are adapted to introduction into our country.
You have been detailed by the Navy Department, upon my request, to make these inquiries, and will conform, in so doing, to the letter of directions of the Department of this date, and to the instructions contained in this.

The countries which it will be certainly desirable for you to visit are Great Britain and France, and perhaps Belgium, where you will obtain such information as will show whether it is advisable to limit your examination to these countries, or to extend it to others. In Edinburgh you will obtain from Alan Stevenson, Esq., important information for your guidance. In Paris the same will be furnished to you by Leonor Fresnel. While inquiring into details of recent improvements in lighting, it will be well to obtain information upon the subject of light-houses generally. Without wishing to limit your inquiries, I indicate the following points upon which information should be collected:

1. The organization of the light-house system—the department of the government in charge of it, and the authorities directing it in these various grades. The system of accountability, and the mode of procuring supplies. In this connection, you should collect the laws and reports relating to light-house systems and light-houses, and procure any standard books treating of such matters.

2. Construction of light-houses.—By whom the selection of sites are made. By whom the plans are made, and how executed. How repairs are made. The cost of construction and repairs of particular light-houses and their appendages. You should, in this connection, procure detailed drawings of light-houses of different classes.

3. The lighting apparatus.—Principles of classification of lights. Different varieties of lights, and the reasons determining their use. The lenticular and mirror arrangements. Under this head you should inquire minutely into the arrangement of all the parts of the light; the mode, cost, and place of making, the lenses, prisms, mirrors, lamps, and other parts of the apparatus used. The nature and cost of repairs. The adjustments required. The kind and cost of the illuminating material; collecting all the necessary information in regard to the use of oil, of gas, to the Gurney, Drummond, Bude, and other lights; to the modes of supply of the illuminating material; to the systems of distinguishing lights, as by fixed, revolving, flashing, or colored lights, and to the results. Facts in regard to the effect of the alleged improvement of lenticular lights should be collected. The prominent advantages and defects of the old and new modes of lighting, or of distributing the light. The circumstances which should determine the use of one or other of the modes of lighting. The distance to which particular lights are visible, and the sector through which they are seen.

4. The arrangements for securing necessary attendance upon the lights; their expenses and efficiency.

5. You will inquire, also, in regard to the classification, construction, cost, and modes of placing buoys, spindles, and other aids to navigation, in difficult channels, and will report the information you may obtain, including the manner of building, fitting up, and mooring light-boats, and the cost of their maintenance, and also such facts as you may obtain in relation to the erection of light-houses on Mitchell's screw-pile.
6. In the course of these inquiries, matters relating to the light-house system or light-houses will necessarily suggest themselves to you, in regard to which the Department should have information, and these you will examine and make report of, as if laid down particularly in your instructions.

In addition to the full descriptive report which the Department expects of what you may have seen worthy of note, and to the information which you may collect, you should make such suggestions as a general review of the subject or your reflections may give rise to, for the improvement of our light-houses.

On your return you will visit some of our principal light-houses, and include your observations in relation to them in your report to this Department.

Very respectfully, your obedient servant,

R. J. WALKER,
Secretary of the Treasury.

To Lieutenants Thornton A. Jenkins,

REPORT.

WASHINGTON CITY, June 22, 1846.

SIR: We have the honor to report, that, in obedience to your orders, we visited Europe in August last, and, immediately after our arrival in London, commenced making inquiries into the subjects embraced in your letter of instructions, bearing date the 19th June, 1845, (hereto prefixed.)

The examinations which we were enabled to make were by no means so full and satisfactory in some instances as we desired, nor as we had anticipated. However, we visited many of the light-stations on the coasts of the Baltic and North sea, English and Irish channels, Atlantic coast of England, and coast of Scotland, besides several depots of supplies and manufactories of illuminating and other apparatus for light-house purposes; from which, the departments having charge of that particular branch of service, and other reliable sources, we obtained such useful information as was accessible to us.

For very valuable information, many drawings, circulars, memoirs, forms, &c., &c., relating to the French light-houses and the system of management pursued in that country, we are greatly indebted, under authority from the minister of public works of France, to the courteous and distinguished engineer secretary to the Light-house Commission at Paris, Monsieur Leonor Fresnel. We are also indebted to the Trinity Board, London, to Mr. Maltby, the secretary ad interim to that board, and to Lieutenant Lord, royal navy, marine surveyor of the port of Liverpool, for very valuable information, drawings, circulars, &c., relating to the Trinity House and local lights of England; and in Scotland and Ireland, to the kindness of Messrs. Alan Stevenson and George Halpin, junior, the engineers to their respective boards, for documents and verbal infor-
mation respecting the management, &c., of the lights confided to their care. The governments of Denmark, Prussia, and Holland very kindly furnished all the desired information, upon application by our ministers in those countries.

Having examined some of our own light-houses since our return to the United States, we beg leave to lay before you the results of our inquiries and observations, accompanied by such suggestions as a general review of the subject seems to indicate, with the hope that our labors may in some degree tend to the advancement of our own Light-house Establishment towards that perfection which is observable in those of Europe.

Following the order of your instructions, we give separately an account of the organization, management, general superintendence, &c., of the light-house establishments of the different countries visited, and refer particularly to the detailed statements in the papers annexed hereto, relating to each of those establishments, which we deem necessary to a correct understanding of the whole subject.

With reference to the organization of the different establishments of Europe, it will be perceived, we infer, that it would be difficult to select either one of them as constituting, in every essential respect, a perfect whole—neither of them certainly perfectly adapted to fulfil the wants of the Light-house Establishment of this country; yet there are parts of each which might be, and we believe ought to be adopted, while those portions which are objectionable, or otherwise not adapted to our country, could be, with equal propriety, discarded in the formation of a plan having for its object the improvement and the more perfect management and superintendence of our lights. In England, for example, the Trinity Board (which is well constituted in very many respects for the service with which it is charged) is burdened with honorary members, pensioners, and numerous officers who receive high salaries, for the support of whom a heavy and extremely onerous tax is levied upon all vessels employed in commerce, which pass the lights, buoys, and beacons belonging to that corporation. As an exemplification of this particular point, it will be merely necessary to state the fact, that out of a revenue of upwards of £300,000 sterling, which the Trinity corporation derives from commerce for the maintenance of lights, buoys, and beacons, only a fraction more than one-third of that sum is expended in the support of the Light-house Establishment proper. This sum does not include the light dues collected by local authority for the maintenance of harbor and other inland lights. It is only the revenue of the Trinity corporation, derived from dues for lights, &c., belonging to and under the special charge and management of that board. No fault can, however, be found with the lights under its control; they are good, and well attended to in every particular. Great judgment is displayed by this board in the selection of sites for new light-houses; none but persons of known judgment and experience in this important branch of the service are selected to perform this duty. The buildings are constructed in a manner worthy of the high reputation of the board, of the engineer charged with the execution of the works, and of the great interests which the lights are designed to protect. The improvements in the illuminating apparatus, in the different means by which to obtain proper ventilation, &c., if not
introduced in all cases as speedily as would seem to be desirable, yet, when ascertained to be undeniably of practical utility, are invariably adopted. Distinctive characteristics are given to all the lights, with special reference to those adjacent to them. A scientific person is employed for the purpose of testing all apparatus designed for the service, and experimenting upon the different combustible materials, to ascertain their relative values, &c. The lights are under the charge of a sufficient number of keepers, and local or district superintendents, and inspected at frequent periods of time by members and committees of the board. These are all very important points of duty, well worthy of imitation, and would be attended with little expense compared to the great advantages which so perfect and systematic an arrangement would confer upon the interests of commerce and humanity.

No dues are levied in France upon commerce to support the lights, as in England, Ireland, Scotland, and most of the northern commercial nations of Europe; but all the expenses of the establishment are defrayed from the national treasury, as in this country.

The engineer to the French lights is also charged with the duties of secretary to the commission, having the control and management of them. He is, in fact, the executive officer, as in Scotland and Ireland; but his duties are in many respects different from those of the two engineers in those countries.

In England, where an engineer is employed and paid to execute any given piece of work, the expense is far greater in the aggregate (without the system possessing any advantages) than it is in those countries where they are permanently attached to the board upon annual salaries, devoting all their time to the constructing, repairing, and improving the light-houses, &c.; and in no instance, that we are aware of, is the work executed under the former system superior to that executed under the latter.

The French lights, &c., are superintended and inspected by the local or departmental engineers of the corps of bridges and roads, the coast being divided into districts, as in England. The engineer secretary to the commission of French lights has, in addition to his other numerous important duties, to make all experiments upon combustibles for the illumination of the light-houses, tests all apparatus for the service, and issues, under authority from the under secretary of state for public works, all the instructions which are from time to time deemed necessary to be given to the engineers, keepers, and other agents of the establishment, to insure a proper and faithful performance of their respective duties.

It has been most clearly demonstrated to our minds, that an engineer of undoubted professional ability is absolutely indispensable to a properly organized Light-house Establishment; without whom that branch of the public service, which, in our judgment, should be guarded with the most jealous care and unremitting attention, to insure all the usefulness which such an establishment is designed to confer, must be subjected to the most atrocious impositions, entailing upon the Government and the interests of navigation evil consequences, which, in many cases, must prove of the most melancholy and appalling character. The useless
expenditure of public money appropriated to accomplish one of the most laudable objects known to legislation, arising from ignorance in the selection of sites; large amounts required annually for repairs; badly constructed light-houses; shipwreck, with all its attendant horrors of loss of life and property, are a few of the evils consequent upon this neglect to employ a responsible person of acknowledged ability to fill a station of so much importance as that of engineer to the Light-house Department of a country like ours; but especially are these evils felt by our seamen, that, of all others, most neglected and unprotected class of people.

By referring to the detailed statements relating to the different Light-house Establishments, it will be seen that very great care is taken to obtain the best oil, subjecting it to the best known tests, and a proper quantity allowed to warrant keepers obeying strictly their instructions as to the time of lighting in the evening and extinguishing in the morning; and also to allow, at all times and under all circumstances, the flames to be kept at their normal height. The mode of procuring supplies will be seen in the statements referred to. The contract system is in most general use. The duties of the keepers should be most rigidly enforced. No keeper should be permitted to decide when is the proper time to light or to extinguish his lights, but should be instructed to light his lamps at sunset, and keep the flames at their most effective height until sunrise. A failure to perform this duty strictly should be a sufficient warrant for his removal.

They burn in the English, Irish, and Scotch lights, "the best winter bagged sperm oil;" and in the French, and most if not all of those of the northern commercial nations, "the best purified and clarified colza, or rape-seed oil." The difference in the price of these oils in Europe is ordinarily very great, and to this difference may be attributed in some measure the greater expense of maintaining the British lights. The subject has been attracting the attention of the Trinity Board for several years past; in consequence of which, experiments have been made both in light-houses and in London, under the direction of a scientific person, to test the relative advantages of the two oils. The results of these experiments have been sufficiently favorable to the colza to warrant us in the belief that it will be generally employed in the British lights at no distant period. We witnessed the experiment at one of the light-houses, in which four of Wilkins's catoptric lamps, with the colza, were employed by the side of Argand lamps with sperm oil. We also witnessed a similar experiment at the shop of an artisan in London, at which two lamps were employed. On both of these occasions the difference in the flames (to the eye) was very perceptible, the colza producing much the whitest and brightest light. It is also asserted that there is less difficulty in keeping the colza oil liquid in winter, and any impurities that may be in it are more easily detected than in the best sperm oil. It is presumed, however, there would be very little economy in substituting the colza for the sperm oil now in general use in our light-houses—at least not to the extent that it produces in Europe, where the sperm is comparatively very expensive; but if it produces a better light, is more easily kept in a proper state for burning during the winter season, and
the impurities arising from the mixture of other oils with it more easily detected, then there can be no reason why it should not be introduced; and, with the view to that end, we respectfully suggest the propriety of having a series of experiments made upon it and other oils by some competent person. The vegetable from which it is made might be, without doubt, cultivated to advantage in the United States, particularly if in the course of events anything should occur to break up, or render unproductive, our whale fisheries in the Pacific. The subject is one which we deem of considerable interest and importance in several points of view, but especially in that which refers to it as a better combustible for illuminating purposes than sperm oil of the finest quality. We are strongly impressed with the belief that to this oil, as much as to the fineness and superiority of the illuminating apparatus, may be ascribed the high reputation, not to say the superiority to all others, of the French lights.

Diligent inquiries were made as to the use of combustible materials for light-house purposes, other than the two kinds of oils already noticed. Gas from coal and from oil is used in many harbor and pier-head lights in England, Ireland, Scotland, and in a few places on the continent, all of which are under local authorities. There are none of the public, general, or sea-coast lights, belonging to any of the commercial nations, illuminated with it, that we either saw or heard of; but experiments have been made to test the practicability of employing it in those lights; and Mr. Alan Stevenson, the engineer to the Scottish light-house board, a person who devotes all his talents and energies to the improvement of the lights under his care, introduces the subject in a communication to the chairman of the light-house committee of the British House of Commons, in 1845. (See subsequent part of this report, and page 561 of the report referred to above.) His statement is sustained by Mons. Fresnel, in a note to this report, and by every one with whom we have conversed upon the subject. Admitting the alleged ease with which gas is generated, and its great economy, still there are higher considerations than those in the management of lights. Its introduction would greatly increase the liability to accidents, and consequently impair the usefulness of the light. A sea-coast light in which confidence has once been lost is worse than useless; the reputation for constancy and stability in a light being one of its most essential requisites in the estimation of all seamen.

In small harbor or pier-head lights, (particularly those sufficiently near gas works, in cities,) or where repairs can be readily made, gas might be introduced without the fear of very serious consequences; yet, in those particular situations, it would be less economical than lights produced by the fourth-order dioptric or Fresnel lens, supplied with a single Argand lamp and burner, which would be equally, if not more brilliant and efficient. We consider that any attempt to introduce gas at this time into our sea-coast or other important light-houses would be attended with great hazard to the interests of navigation. Experiments have been made in Great Britain and France, within the last ten years, upon the Drummond and other lights produced by chemical action, the results of which have proved them to be totally unadapted to the light-house service. The Drummond light having been proved to be much more powerful than any other, great efforts were made to adopt it as an auxili-
ary to the ordinary lights; but having failed to accomplish that object, it has been abandoned.

Notwithstanding the failure to improve the lights by chemical means so far, rapid advances are being made towards perfecting the illuminating apparatus of light-houses; and although it has been found impossible to procure a sufficiently powerful ray to penetrate a fog, yet, by these late improvements, the power and range of the lights have been so increased as to render them effective at much greater distances than formerly. France and Scotland vie with each other in these laudable measures, while the other nations of Europe seem readily disposed to adopt the improvements made by the indefatigable engineers at the head of the French and Scottish light-house commissions.

The examinations which we have made in relation to the advantages and disadvantages arising from the use of different modes of illumination, have convinced us of the very great superiority of the Fresnel apparatus to all others, and we cannot too strongly recommend its introduction into our light-houses. This apparatus needs only to be examined and understood to be appreciated. We are confident no one can study this most admirable and unrivalled piece of mechanism without being convinced not only of its usefulness, but of its superiority in every point of view to all other apparatus adapted to the illumination of light-houses.

The arguments of Mons. Leonor Fresnel (the brother of the illustrious inventor) would, we think, suffice to satisfy any unprejudiced person; but in addition to all that Monsieur Fresnel has stated, and to all the results of experiments made in France, Scotland, &c., we have the evidence of nearly all the commercial nations of the world, except the United States and Russia, of the practical value of this apparatus.

We refrain from enlarging upon the many advantages which the system of Fresnel possesses over all others for the illumination of maritime coasts, but refer with confidence to its whole history, from the time of fitting up the Cordouan tower, in 1823, to the conclusive evidence supplied by Mons. L Fresnel, Mr. Alan Stevenson, and others, hereto annexed; to the opinions of Sir David Brewster, Messieurs Arago, Mathieu. De Rossel, and a host of other distinguished scientific persons in Europe; and also to those of many competent individuals in our own country who have studied the subject, to sustain us in the conclusions we have arrived at, that this system is as well adapted to this country as to those in which it has been successfully introduced; that it produces far better and more economical lights than any obtained from reflectors, either in Europe, where they are of very superior, or in this country, where they are of very inferior quality; that the dioptric apparatus of Fresnel is more difficult to put out of adjustment, and less liable to accident and derangement from carelessness on the part of keepers, than the catoptric, as it exists in this country at present; and that in every point of view the lights are superior to any that could be produced by any combination of reflectors in lanterns whose dimensions are not beyond all practicable and reasonable limits.

It has been objected that great danger is to be apprehended from the employment of the one lamp; that the most serious consequences would result from its going out during the night; and that it would be very
difficult to keep it in proper repair, &c. These objections are fully and satisfactorily answered by the practical experience of upwards of twenty years in Europe, and by the well-established fact, that the French mechanical lamp is so perfectly constructed in Paris that it does not require repairs, ordinarily, for three or four years after it has been put in use. With equal propriety, and as much reason, might the employment of clock-work for revolving and other movable lights be objected to; yet such lights are to be found everywhere. Again: it is asserted that if this apparatus and lamp are employed, an increase in the number of keepers will be required. This certainly cannot be urged as an objection by any who believe in the necessity of having efficient lights along our coast. The higher orders of dioptric lights require two keepers, and we consider it equally important that this number should be allowed to all sea-coast and other first-class lights. In this opinion we are sustained by the practice of the whole of maritime Europe. In France, and some of the other continental countries, a larger number of keepers is allowed to the dioptric than the catoptric stations; but in Great Britain, where the lights are equally well attended, no difference is made in this respect. All lights, but more especially those of the class referred to, require strict attention and great care to insure to them the greatest useful effect of which they are susceptible; without that care and attention, let the apparatus be ever so good, and the establishment maintained at ever so great an expense, they will fail to fulfil perfectly the purposes for which they are designed. No sea-coast or other first-class light should ever be left between the times of lighting and extinguishing without a keeper. The draught of air in the lanterns increases and decreases with the force of the wind outside of the tower, thus rendering it necessary to change the height of the wicks, even when the Argand lamps and burners in common use are employed, to suit these changes; in fact, the whole time of one person will be fully and profitably employed in keeping the flames, glass chimneys, glass of the lanterns, and the other necessary fixtures of the light-room, in proper order. Establish the principle that the lights may be left alone, as is necessarily the case where only one keeper is allowed, and an excuse for any accident that may occur will be always ready, in bar to the charge of neglect of duty, however palpably true the charge may be in the estimation of disinterested persons.

It would be a libel upon our country to say that persons cannot be procured capable of managing these lights. It will not be believed that faithful and competent persons cannot be obtained in this country for this duty with as little difficulty as in France, Holland, Denmark, Norway, Sweden, England, Scotland, Ireland, &c. Persons of as much if not more intelligence than those performing this duty in the countries named above are now employed in our light-houses; and if they are furnished with proper instructions relative to those duties, and do not obey them strictly, they should be, and no doubt are, dismissed from their stations. This subject, in our opinion, is one of great importance, and merits the particular attention of the Government; for upon the proper organization of this branch of the service mainly depends the
success of any attempts that may be made to improve the lights on our coasts.

Independently of the means placed at our disposition for arriving at correct conclusions in relation to the employment of the Fresnel apparatus, the opinions of the scientific world would seem sufficient to warrant the recommendations which we have made, and we most cheerfully rest our own strong preference for it on those expressed opinions. All new lights, and those to be refitted, should be supplied with dioptic apparatus of the most approved and improved construction; and the sea-coast and other first-class reflector lights should be gradually changed, which would insure greater intensity of light, an additional number of distinctions, and a saving in the consumption of oil; all of which are objects of the greatest importance in the present state of our lights. The interests of commerce and the cause of humanity forbid that the lights on our coast should be in any respect inferior to those on the coasts of the other great commercial nations of the world. A nation having so great and growing a commerce as ours, should rather set an example to others, by pointing out dangers on its coasts and in its harbors, than be content with the idea of having once had as perfect a light-house establishment as was to be found.

The reflectors in general use in Europe for coast lights are parabolic in shape, and 21 inches in diameter. In some of the Scotch revolving lights the parabolic reflectors employed are 25 inches in diameter. These reflectors, without exception, are made in the best manner, the plating of very superior quality, and most highly finished. The high state of perfection in which the whole of the illuminating apparatus was found in those light-houses afforded ample evidence of the great industry and carefulness of the keepers in charge, and of the superiority of the manufacture of the reflectors, lamps, burners, &c. The solidity of the frame, and the manner in which the reflectors and lamps are secured to it, render it impossible, except from the most wilful and culpable carelessness or design, to put them out of adjustment. The lamps vary somewhat in form and in the manner of securing them to the frame; those in the Scotch light-houses are the most beautiful and complete in their arrangements, although it is probable they are to some extent more expensive. The burners in general use are one inch in diameter.

Great care is bestowed upon the construction of light-house towers in all parts of Europe that we visited; and they stand not only as beacons to guide the mariner, but as monuments of the ability and faithfulness of the engineers and constructors. The effects of dampness are sometimes seen on and in the towers, but not very often. The interior of the towers is ordinarily lined with brick, plastered and painted, leaving sufficient space between the two walls for a proper ventilation. Many of them are plastered and painted, or rough-cast, outside. Every possible care is taken to keep the towers, lanterns, oil cellars, and store-rooms free from dampness. The oil cellars, when it is practicable, are below the surface of the earth, where the temperature does not change more than three or four degrees during the year. The oil is kept in large tin tanks, fitted with conducting pipes, cocks, &c., which, with ordinary care and attention, must keep it always in good condition for
use, and insure cleanliness in the apartment. The storerooms for the other necessary supplies are generally placed over the oil cellars, in which are found every article, in perfect order, necessary to the keeping of a good light. In some cases the towers are without lightning conductors. In Scotland all are in that condition. In England, the attention of the Trinity Board has been recently drawn to the necessity of employing them, and orders have consequently been given for their general introduction.

The buildings for the keepers are generally at a short distance from the towers, and are arranged in their interiors with the same care and attention that is observable in the towers, and kept in equally good order.

The special committee of the British House of Commons which made its report upon light-houses in 1845 called the attention of the Trinity board, Northern lights, and Irish boards to the subject of constructing light-house towers of iron. Several light-houses of this material have been constructed in England and sent to the colonies. They are very highly approved of for certain locations, but disapproved of by many engineers for locations which are liable to be overflowed by the sea, for the reason that a proper foundation cannot be made for them under such circumstances.

The season of the year deterred us from visiting any of the celebrated "rock-lights;" besides which, we considered that our mission was designed entirely for practical purposes; and as no special good could result from an examination of the Cordovan, Bell-rock, Eddystone, &c., (those wonderful specimens of architecture which have been for years past the admiration of the world,) we contented ourselves with seeing some of the lights of the oldest and most modern construction, and with observing the improvements in the modes of illumination, up to the time of our visit. As the illuminating apparatus is improved, the number of new lights is augmented. Since 1834, France has added 80 to her list, England 50, Scotland 15, and Ireland 20; besides these, there have been renovations and other improvements of old ones, to increase their power, range, and general efficiency. Other countries are equally active in this branch of the public service. The North sea and Baltic are studded with fine lights, yet new ones are being erected and old ones renovated and fitted with the Fresnel apparatus of the latest construction. It will be seen that the modes of distinction employed in the lights differ very greatly in those countries. The largest number of distinctions (nine) will be found to exist in France and Scotland. Red is the only color employed in forming those distinctions; all colors being objectionable, but that less so than any other. At present there are on our coasts, of the 270 lights of all kinds, 28 revolving; 3 revolving red and white; 11 fixed light-stations with two towers each; 3 stations, two towers each, with fixed and revolving lights; 3 stations with two lights in one tower; one station with three towers, fixed lights; 3 red fixed lights, and one fixed red and white light; yet, from the very limited number of lights distinguished from the simple fixed lights, and from the want of arrangement of them, it can scarcely be said that we have any distinctions at all. A systematic arrangement of all the lights on the coast, giving to each a positively distinctive appearance, can alone fulfil all the wants of
a difficult and hazardous navigation. With the number of distinctions
now in common use, nothing would be easier than to mark every sea-
coast light so that it would present itself to the mariner at first sight in
such a manner as to forbid his mistaking it for another. This subject
is one of great importance, and has occupied much of the time of the
European light-house engineers. Two lights in one tower, for any other
than harbor or inland purposes, are worse than useless, from the fact
that at a very short distance the two lights blend and appear as one.
For a harbor where a distinction is absolutely necessary in consequence
of a large number of adjacent lights, it may answer, but under no other
circumstances. Two or more towers at one station, unless placed for
ranges or leading marks, or in the vicinity of many undistinguished
lights, where other and simpler modes cannot be employed with advan-
tage, are unnecessarily expensive, and in some cases fail to produce the
desired distinction.

The local authorities charged with the management of the harbor and
other inland lights in Great Britain pay particular attention to them;
lighting the approaches to and into the different ports, in a manner much
to be admired. Colors (chiefly red) are employed for distinctions by
these authorities, there being less objection to using them for those lights
than others, from the limited distance at which they are required ordi-
narily to be seen.

In the bay and harbor of Liverpool, and other parts of Great Britain,
the lights are placed and masked with so much skill and judgment, that
vessels enter these harbors in cases of stress of weather, or other neces-
sity, without pilots, and run with perfect safety to good anchorage,
notwithstanding the extreme narrowness and intricacy of the channels,
with dangers on every side of them.

The light-vessels in England are fitted with Argand lamps and burners,
and parabolic reflectors, for both fixed and revolving lights. The illu-
minating apparatus is arranged around the mast or masts of the vessel
in such a manner (with balls, cups, and gimbals) as to insure, as nearly
as may be, its perpendicular position at all times. Notwithstanding the
very great care taken with these lights, they produce but an indifferent
effect compared to those on land. The vessels are well found in all
respects, securely moored upon the most approved plan, and every possi-
ble precaution taken to keep them in their proper positions; yet acci-
dents occasionally occur, causing loss of property, and maybe life. In
consequence of these casualties, various methods have been suggested,
and warmly advocated, for placing fixed or permanent lights upon the
dangerous sands and shoals, as substitutes for light-vessels. Many ex-
periments have been made to test the usefulness of these inventions, but
the screw pile of the Messrs. Mitchell, of Belfast, only, has so far suc-
cceeded. We feel no hesitation in calling your particular attention to
this invention, and recommend it as being admirably adapted to many
places on our coasts where light-vessels are now stationed. We feel the
greater confidence in recommending it for light-houses under certain
circumstances, from the fact that we are but repeating the opinions of
many distinguished engineers, and others, in this country and in Europe,
who have had ample means of examining the subject, and of forming opinions after the most mature deliberation.

We believe a judicious introduction of this invention, as a substitute for floating lights, would greatly add to the safety of the navigator, and diminish the expense of the lights.

The system of buoyage in Great Britain seemed to be very perfect. The difference is very perceptible between the systems practised there and in this country. It is a branch of the service in which navigators are deeply interested, and one certainly of great importance to them. It therefore should not be neglected, much less placed in the hands of incompetent or irresponsible persons. We should fail in the performance of our duty, if we did not solicit your special attention to this subject, and recommend that such steps may be taken as may be necessary to insure a systematic arrangement of all the buoys in our bays, rivers, and harbors. They should be put in their places, in the first instance, by competent persons, assisted, if necessary, by those who are familiar with the wants of the local navigation. Their positions should be properly determined by angles, measured between well-established stationary points on shore. Journals should be kept by the district superintendents of all the buoys in their districts, noting the angles, bearings, &c., of them. They should be kept well painted, frequently examined and inspected, and the distinguishing marks so plain as to forbid the possibility of one being mistaken for another. In England the authorities are so particular, and the subject considered by them of so much importance, that no buoy can be placed, nor its position changed, without first obtaining the sanction of the Trinity Board. Due notice is then given of the proposed new buoy, or change of position of an old one, through the medium of the press, and by means of handbills put up in the custom-houses and other public places where seamen resort. Iron buoys and iron sinkers for mooring them are coming into very general use in Great Britain. Those of the most approved shape and construction are made of this material, and employed by the trustees of the Liverpool Dock Company for that bay and harbor; and also by a few other authorities in the kingdom. The manner of mooring buoys differs very much: in some parts of Great Britain stone blocks of different shapes are employed, while in others iron blocks for the same purpose are used, but generally differing in shape in each locality. The screw moorings of the Messrs. Mitchell are admirably adapted to buoys for one or more vessels to ride by, in a rapid current or tide-way. They may also be used with great advantage for mooring buoys in places where they are liable to be swept from their positions in consequence of the peculiarities of the form of the danger which they are to mark, or where it may be the interest of malicious persons to destroy the channel marks. Moorings very similar to these are used in some of the channels on the coast of France, where the tides are very strong, and where it is very desirable that the channel buoys should not get out of their places. The screw moorings are in very general use in Great Britain for vessels to ride by, and are very highly approved of by all with whom we conversed upon the subject of their employment.

In addition to a perfect system of buoys, beacons are highly necessary
to insure more certain and distinct guides to channels. Iron beacons, similar to the one erected by the Messrs. Mitchell upon the Kish bank, in the Irish channel, might be employed most advantageously in many situations as substitutes for those of masonry. No harbor, at all difficult of access, should be without these artificial aids to navigation, as a trifling expense for these objects may be the means of saving many thousands of dollars' worth of property.

The lights of Great Britain and France are supplied with clocks, barometers, thermometers, and, at tidal stations, with tide gauges. The keepers are required to keep a meteorological journal, and tide tables, noting at regular specified periods, in a column of remarks, the appearance of the weather, direction and supposed force of the wind, &c. These journals and tables are forwarded monthly or quarterly, with the other reports, to the superintendents, or other agents of the establishment, and by them to the executive officer or board charged with the control and management of the lights.

We recommend that these instruments be furnished to important stations, and that the keepers be required to perform these additional duties, as they will subserve the best interests of the country by acting as a most useful check upon the keepers, and at the same time be the means of procuring information of great value. They should also be required, as they are in Europe, to keep an account of the daily expenditure of oil; to note, immediately after lighting their lamps in the evening, and at regular stated periods during the night, what lights are in sight, and their distinctive characteristics or appearances. These returns should be examined at the end of each month by the district superintendents; approved, if correct, by them, and transmitted to the general superintendent.

It will be seen that although all the boards differ in their modes of inspection and superintendence, yet the lights are not neglected by any of them: on the contrary, they undergo the most rigid scrutiny by persons who are not only fully competent to judge of the condition and quality of the lights, but also to point out the remedies for any defects that may exist in the illuminating apparatus, lanterns, combustibles, or buildings.

In France and Great Britain the general superintendence and inspection are such as to subserve perfectly every interest of the service; the evidence of which is to be found in the attendance upon the lights, and the good order and cleanliness visible everywhere.

Without referring further, in this connection, to the European lights, and the boards under which they are placed, we will proceed to remark briefly upon those of our own country, and of the manner in which they are controlled and superintended. We have visited some of the lights in the vicinity of New York, in Chesapeake bay, and at the capes of Virginia and Delaware, &c.; besides which, we have seen many of the lights on the coasts of Maine and Massachusetts, in Long Island sound, and Chesapeake bay. These visits and observations have enabled us to draw, as we believe, a fair and just comparison between the lights on our coasts and those of other countries; and we feel constrained, although with deep regret, to state that ours are far inferior to any and all we
saw during our visit to Europe. This inferiority is strongly marked in the towers, buildings, lanterns and their fixtures, in the illuminating apparatus, and, in general, in the attendance upon, and the supervision of the lights. The lamps are of decidedly bad construction; the reflectors, with a single exception, of an inferior description; and both lamps and reflectors so badly attached to their frames that it would be almost impossible to keep them in perfect adjustment: as it is, very few of them even approximate to it.

From the manner in which the keepers are permitted to enter upon their duties—taking charge of lights without any previous knowledge of or instruction in the duties of such an establishment—it is not so surprising that many of them are in bad condition, and not properly attended to.

We do not mention these facts for the purpose of casting censure or odium upon any one, nor can we take any pleasure in thus pointing out such palpable defects in our Light-house Establishment, yet they serve to show the necessity for changing the present mode of managing them, a measure which we trust will meet with sufficient favor to insure its speedy accomplishment.

We forbear to enter into further details upon this subject, trusting to accomplish all that will be desirable by pointing out, as we believe, the remedies for most if not all of the evils complained of.

We, therefore, most respectfully recommend the reorganization of our Light-house Establishment, by the appointment of an engineer, an optician, and a proper number of district superintendents, to assist the general superintendent of lights, buoys, and beacons, under the direction and control of the Secretary of the Treasury.

Under this organization the duties of the general superintendent would remain pretty much as they are at present; those of the engineer (who might be detailed with propriety from the Army) would be to make all plans, drawings, and specifications of works, assist in the selection of sites, superintend the construction and repairs of all towers, buildings, &c., inspect at least once a year the principal light-stations, report the condition of the lights, and suggest such improvements and repairs as he may deem proper and necessary. The duties of the optician would be to superintend the construction of and to test all illuminating apparatus, make all experiments upon apparatus and combustibles for light-house purposes, visit all the lights at least once a year, with the view to directing the adjustments and repairs of the fixtures of the lanterns, &c. These duties, if faithfully performed, would occupy all the time of the engineer and optician.

The coast should be divided into districts, and each district placed under an officer of the Navy as superintendent of light-houses, light-vessels, buoys, and beacons. Eight or ten superintendents would be required to perform faithfully and successfully all the duties of this service—say eight on the Atlantic and Gulf coasts, and two on the lakes. Each of these superintendents should be supplied with a small vessel, to enable them to inspect, at least once every month, the floating lights, light-houses inaccessible by land, and all the buoys and beacons in their districts. They should also be required to establish the positions by
angles, and place all new buoys, and replace those requiring paint or repairs, keep journals and descriptive tables of all buoys, specifying when placed, when repaired, when painted, and the angular points, bearings, &c., from other buoys, lights, and beacons. They should also be required to examine the moorings of light-vessels and buoys at regular intervals of time, and make regular quarterly and monthly reports of all matters coming under their observation relating to navigation within their districts to the general superintendent, besides informing him immediately upon the occurrence of any accident, or any other cause affecting the usefulness of the lights, &c., under their charge. They should receive, test, and deliver to the different keepers all supplies, with the small vessels under their commands, under orders from the general superintendent. All information obtained from pilots, light-keepers, and others, in relation to the lights, buoys, beacons, channels, &c., in their respective districts, should be reported to the proper department quarterly. In reference to this subject, we beg leave to refer to the following extracts:

In House Doc. No. 811, 27th Congress, 2d session, the committee say:

"In the opinion of the committee, there should be established a plan of inspection more efficient. Frequent visitations, and minute examinations, by competent inspectors, would insure vigilance, economy, and order on the part of the keepers. The inspectors should be men thoroughly acquainted with all the details of light-house management and superintendency, with the manner of adjusting the lamps and reflectors, and of keeping them in good order."  *  *  *  "The collectors, acting as superintendents, cannot possess that information and practical knowledge necessary to a perfect administration of the system. The mode of conducting it has formed no part of their studies. They lack both theory and practice."

In a report made to the Senate by the Committee on Commerce in 1838, (Senate Doc. No. 428,) it is said: "The lights should be visited by a general inspector, who is master of the whole subject, being fully capable of estimating the true character of the apparatus, its condition, the manner in which it is managed whether the keepers are capable and faithful, and whether the oil is such as it should be. In short, this visitor should be so thoroughly skilled in everything pertaining to the subject as to keep the light-houses in as perfect a condition as the arts and the progress of science will allow." Again: "We have already said that certain collectors of the customs are the inspectors of light-houses in their respective districts. It is manifest the two offices have no natural connection, for they require qualifications quite different. The one should understand the laws of light, as it is affected by reflectors and refractors; the other, the character and value of merchandise, (and there is no affinity between the employments;) nor does it follow that one who is well qualified for a collectorship has a particle of that information which is essential to a well-conducted system of lights." Again: "The number is great; the duty is merely collateral; their visits are seldom; their attention little engaged in the matter. They have no control over the system—have no knowledge beyond their districts; and the consequence is, that their inspection is generally of little importance,
and has little tendency to expose the faults or improve the character of the system. Indeed, so necessary is some other inspection, that the contractors who furnish oil are required to view and report upon the condition of each light, and so, also, are the immediate keepers. The subject was early committed to the collectors as a matter of convenience, but we may well inquire now whether its importance does not call for a more skilful supervision—one that can give harmony and character to the whole system, and make it not only keep pace with the progress of population and business, but with the advancement of mechanical and scientific improvements."

The committee (Document No. 811, 2d session 27th Congress) say further: "In the opinion of the committee these views are entitled to the respectful consideration of Congress." "The appointment of inspectors, whose duty it shall be to devote their entire time, under the direction of the general superintendent, to frequent examinations of the light-houses, light-boats, buoys, &c., would be attended with no great increase of expense. The amount now paid to the collectors acting as superintendents is about eleven thousand dollars. There is already attached to the establishment a small vessel."

We would further recommend that a depot for oil, spare buoys, moorings, and other supplies, be established in each of the proposed districts, and placed under the charge of the district superintendents. There should not be less than two keepers to each of the sea-coast and first-class lights, and they should never be allowed to be left, after lighting in the evening at sunsetting, until extinguished in the morning at sunrising, without a keeper. The keepers should be furnished with printed general and detailed instructions, similar to those supplied to the keepers of the European lights. These general instructions should be printed in large type, on single sheets, framed, and hung up in the keepers' dwellings, and in the trimming rooms of the towers. They should embrace all the most important points of duty, such as the times for lighting and extinguishing the lights; the times for cleaning and preparing the lamps, reflectors, or other apparatus for lighting in the evening; general routine duty in the lantern at night; journals; returns of oil expended daily; quarterly returns, &c.

The detailed instructions, which might be furnished in small pamphlet form, should contain directions for executing every duty connected with the light-house establishment; enumerating the different lamps and apparatus, revolving and other machinery, &c. No better guide could be followed in this respect than the instructions, circulars, &c., which have been issued by the French administration. Proper forms, journals, &c., should be furnished, also, to enable them to make their monthly and quarterly returns to their respective district superintendents, who should be required to transmit them, with such remarks as they may deem proper to the general superintendent of lights.

In addition to these, clear, full, and explicit instructions should be furnished to each of the district superintendents, to guide them in the performance of their duties. They should also be furnished with journals for remarks relating to the service, for buoys, expenditures, &c., and
such forms for monthly and quarterly returns of expenditures, &c., as may be necessary to be made to the general superintendent.

The general superintendent should be required to give due notice of any proposed change in lights, buoys, &c., through the medium of the most widely circulated commercial newspapers; by the distribution of handbills to our consuls at foreign ports, and by placards in our custom-houses, exchanges, reading-rooms, &c.

Having specified such of the most important improvements as we consider necessary to be made to render our lights and their appendages as efficient as they should be, we now respectfully beg leave to recommend the appointment of a commission, to classify and arrange systematically, with reference to their order, range, and distinctive characteristics, all lights at present existing on our coasts, those proposed to be erected in localities already designated, and to examine into such other subjects relating to the light-houses, buoys, and beacons, and their management, as may be deemed proper by the Secretary of the Treasury, under whose direction it should be, and through whom it should report to Congress.

We would suggest that this temporary commission should be composed of the general superintendent of lights, buoys, and beacons, as president, the superintendent of the survey of the coast, two officers of the Navy, of rank and experience, one military and one topographical engineer from the Army, and a junior officer of the Navy as secretary to the commission. The duties of this board or commission would in many respects be similar to those of the one which was instituted in France in 1819, for a similar purpose, and which produced the celebrated memoir and programme of Admiral De Rossel, which has continued up to the present time to be the basis of the French system of illumination.

The want of judgment, evident to every unprejudiced mind, which has been displayed in the selection of sites, construction, giving distinguishing characteristics, and the general arrangement of the lights on our coasts, and on our bays and rivers, renders, we think, the adoption of this recommendation at this time one of peculiar importance to the general interests of the country, and most particularly to those of navigation. We believe this board would, upon examining into the subject, recommend a reduction of the number of lamps and reflectors at present employed in nearly all of our harbor and other inland lights; if, indeed, the use of reflectors should not be abandoned for the more economical and equally efficient smaller classes of French lens lights, thereby greatly lessening the expense of maintenance, without in any manner diminishing the power and useful effects of the lights. Another, and a much more important point, would be gained by the appointment of this commission—that of obtaining an increased power, range, and efficiency in our sea-coast and other first-class lights, by an addition to the number, and an increased size of the reflectors; the employment of Argand lamps and burners, of the latest and most approved construction; and by the gradual and judicious introduction of the dioptic or Fresnel apparatus, with improved revolving machinery, lanterns, ventilators, &c. Another and a most important duty, which would devolve upon this board, would be to classify all the lights, and introduce such a number of distinctions into our system as to forbid the possibility of one light being mistaken
for another; to examine and report upon all the petitions for new lights; decide upon the necessary power, range, and the proper distinctions to be given to those proposed to be established, &c.

The attention of this board should be particularly directed to the wants of our coasts, bays, rivers, and inlets, from Cape Henry to the Rio del Norte, a distance along the seaboard of nearly 2,500 miles, and upon which there are at present but fifty-six lights of all classes and descriptions, to guide the thousands of vessels freighted with the millions of dollars' worth of the products of our western, southwestern, and northwestern States, which pass annually through the Gulf and Florida pass, along one of the most intricate and dangerous sea tracks known to navigators. The great northern and northwestern lakes, with their immense and daily increasing commerce, would also claim especial attention. Other obviously necessary reforms and improvements, which we deem unnecessary to specify here, would doubtless be recommended.

We have recommended the appointment of the superintendent of the coast survey as member of this temporary commission, for the reason that the branch of the public service over which that officer presides is very closely allied, in a nautical point of view, to the light-house establishment, and that he possesses more facilities for procuring correct information upon the subject, in the course of his duties, from persons deeply interested in our sea-coast and inland navigation, than any other officer in the employment of the government, independently of other and equally important considerations, which we deem unnecessary to enumerate here. The employment of the two engineers as members of this proposed board seems to us so obviously proper and essential, that we deem it unnecessary to assign any reasons for our recommendation of them. We have also recommended the propriety of selecting seamen to assist in the execution of this special service, because we believe that none but persons of that profession, of undoubted capacity and judgment, can fully estimate many of the wants of a light-house establishment. We have been induced, for the same reasons, to recommend the employment of officers of the Navy to perform the duties of district superintendents. Independently of the incalculable benefits which would accrue to navigation from the employment of intelligent Navy officers, whose professional knowledge and sympathies fit them peculiarly for the duties of this branch of the public service, the country would derive many advantages from the knowledge they would gain of the coast and inland navigation of their respective districts. Other reasons might be assigned in support of these recommendations; but as we cannot conceive the possibility of their being objected to by any disinterested persons, we will merely add, that it will be seen, by referring to another part of this report, that we are well and ably sustained in these opinions by distinguished individuals who have devoted much time to the study of the subject, and by the composition of many of the boards in charge of light-house establishments in Europe.

Should these recommendations be adopted, the only additional expense which would be incurred would be for the salaries of the additional keepers to be employed in the large or sea-coast lights, and that of the optician. The engineer, being an officer of the Army, would receive his
salary from another department of the Government, whether employed upon this service or not. The eight or more superintendents, being officers of the Navy, would be paid by the Navy Department; and, with the exception of a very small increase, would be paid whether employed upon this service or not; thus saving to the country, and to the light-house establishment in particular, the amount (say from ten to twelve thousand dollars) now annually paid to the collectors of ports as superintendents of lights, &c. The small vessels or tenders would save the present expense of transportation of the different articles of supply, of placing, replacing, and examining the buoys, and inspecting the lights; an amount which would doubtless prove equal to that necessary to support these vessels.

We believe a light-house establishment based upon such a system as we recommend would produce incalculable good, by perfecting our lights, buoys, and beacons, and ultimately prove a great saving of expense to the country.

We are aware that we have only repeated in this report many suggestions already made to the Department upon this subject; but in seeking means to improve the condition of our lights, &c., we have preferred those recommendations of others which seemed to us based upon a just conception of the whole subject, to those of a more novel and doubtful character. In concluding this part of our report, we beg leave to say that our conclusions have been arrived at after a patient and laborious investigation of the whole subject, so far as our time and means have permitted, and that the changes which we have proposed, or some other equally important ones, are absolutely necessary, to place our lights, buoys, and beacons in a proper state of efficiency, to compare favorably with those of the other maritime countries of the world, and thereby fulfill, as perfectly as may be, the laudable purposes for which they are designed.

We avail ourselves of this occasion to tender through you, sir, our thanks to the honorable Louis McLane, minister to Great Britain, the honorable William R. King, minister to France, the honorable Henry Wheaton, minister to Prussia, the honorable William W. Irwin, chargé d'affaires to Denmark, the honorable A. Davezac, chargé d'affaires to Holland, Mr. Thomas Wilson, our consul at Dublin, and Mr. J. R. Crosskey, our consul to Cowes, for their kindness in affording us facilities for procuring information upon the subject of our mission.

We have the honor to be, very respectfully, &c., your obedient servants,

THORNTON A. JENKINS,
Lieutenant, U. S. Navy.

RICH. BACHE,
Lieutenant, U. S. Navy.

To Hon. R. J. Walker,
Secretary of the Treasury, Washington.

30 L H P
LIGHT-HOUSE PAPERS.

GREAT BRITAIN.

LIGHTS, BUOYS, BEACONS, AND SEA-MARKS.

The light-houses of Great Britain consist of two classes:
1. Public general, or coast lights.
2. Harbor or local lights.

These two classes of lights may be placed under the five following heads:

1. **Trinity House Lights.**—The English public general, or coast lights, which are under the charge and management of the Trinity House corporation, of Deptford Strond, London.

2. **Scotch Lights.**—The Scottish public general lights, which are under the control and management of the board of commissioners of northern lights, Edinburgh.

3. **Irish Lights.**—The Irish public general and harbor lights, which are under the control and management of the ballast board of Dublin.

4. **Local or Harbor Lights.**—The local or harbor lights, which (with the exception of those of Ireland) are under the charge of their respective corporations or local trustees—such, for example, as the screw-pile light at Fleetwood, mouth of the Wyre; the Trinity House board, of Newcastle-upon-Tyne; the corporation of Liverpool, &c.

5. **Colonial Lights.**—The colonial lights, which are under the charge and management of their respective governments or corporations, with some exceptions.

**Trinity Board Authority.**

The Trinity House board has, in addition to the public general lights on the coast of England, the charge and management of several of the colonial lights. This board has been authorized, by an act of Parliament of 1836, to extend a general superintendence over all local or harbor lights throughout the kingdom; to require its approval respecting the alteration of old or the erection of new lights; and, also, as regards the alteration of or the laying down of new buoys.

"Every place that wants to put up a local light applies to the Trinity House for their sanction, and they give directions for the sort of light, whether it should be a red light or a white light, so that it should not interfere with the general coast lights."

**Lights in the United Kingdom.**

The aggregate number of lights in the United Kingdom in 1845 was 309. Of that number 121 were public general or coast lights; 29 floating lights; 181 local or harbor lights, under local authorities, including a screw-pile light and pilot station in Belfast bay, which belongs to the corporation of that city; and 28 harbor or local lights, under the management of the ballast board of Dublin.

The buoys, beacons, and sea-marks are under the charge and management of their respective light-house establishments.

No new light-houses can be erected without the consent and approbation of the Trinity House corporation, of Deptford Strond.
THE LIGHT-HOUSE ESTABLISHMENT OF ENGLAND.

The light-houses, buoys, beacons, and sea-marks, of a public general character, on the coasts of England, are under the control and management of the Trinity House corporation, of Deptford Strond, London.

This board is composed of one master, four wardens, eight assistants, and eighteen elder brothers. Of these thirty-one members eleven are honorary, being considered noble, or in the honorable line of the brotherhood; and the remaining twenty are active members, who, being retired commanders in the commercial marine, perform all the duties of the corporation. The honorary members consist of admirals in the Navy, ministers of state, and other persons of distinction. The corporation has also attached to it an unlimited number of younger brothers, who are generally selected from the commercial marine upon the nominations of the elder brethren, in conformity to prescribed rules and under certain restrictions, from among whom all vacancies in the memberships of the elder brethren are filled.* At present there is only one officer of the Navy attached to the Trinity Board.

There is a secretary to the board, an accountant, collector, &c., and a number of clerks, under the heads of secretary's office, collection office, ballast office, and general collection account office.

The board of twenty active members is divided into eight committees for the transaction of the business of the corporation.

One of these is styled the "committee of light-houses," composed of four members, and has charge of all subjects relating in general to the light-house establishments, and especially to those with regard to the procuring supplies; the superintendence and inspection of all lights, buoys, beacons, &c.; the general supervision of the light-keepers, masters and crews of floating lights; the examination of the accounts of the agents, superintendents, &c.

The "committee of wardens," composed of the deputy master and four wardens, takes charge of all subjects of a very special character, and of the particular department of the treasury and accounts. Notwithstanding all the accounts are under the general superintendence of this committee as a body, they are nevertheless under the especial management and control of an individual called the "Rental warden," who prepares all accounts for general audit. All accounts are subject to inspection and examination.

The general audit takes place before the board quarterly, when it is usual for every member to be present.

The committee for the "examination of masters in the Navy, and pilots," composed of four members; it also examines all subjects submitted in relation to navigation and nautical science.

The committee for the "collection of dues."

The committee for the "supervision of ballastage in the river Thames" is composed of two elder brothers.

The committee for "pilotage," composed of three members, has charge

*The Parliamentary committee of 1834 recommended to the Trinity House corporation the gradual introduction into that body of officers belonging to the royal Navy. Since that period, three have been appointed.
of all matters connected with the system of pilotage throughout that portion of the kingdom to which the jurisdiction of the corporation extends. The committee of "pensions" is composed of four members. All petitions for pensions and general charities are referred to this committee.

The committee for "house affairs," composed of four members, has charge of all the house-keepers' departments.

The committees sit one day in each week regularly, and oftener if any business should require them to be called together at irregular periods.

The deputy master is _ex officio_ chairman of all the committees, and presides as such when occasions require the exercise of his privilege.

The agents are appointed by the board. They reside upon the spot; visit the lights under their care very frequently; take care that the keepers perform their duties punctually and faithfully; receive all supplies of oil and other stores; superintend all minor repairs; pay the salaries to the keepers, and other authorized bills upon the light-house establishment. These local agencies are being abolished gradually by the Trinity Board, and district superintendencies substituted in their places. Each district superintendent is provided with a vessel, by which he is enabled to visit floating lights and those situated upon rocks or isolated points. These superintendents are generally retired commanders, or persons who have been educated in the mercantile marine service. Quarterly reports are made by them to the board, embracing the expenditures of all stores, except oil. Monthly reports are made of the consumption of oil, with such remarks as the superintendent making the report may think proper to add. All the agents and superintendents are paid salaries. A civil engineer (Mr. James Walker, of London,) is employed by the Trinity Board, who directs all the important works of the corporation; such, for example, as drawing plans and specifications for new light-houses, attending to their erection, making important changes and repairs in old ones, &c. This officer does not receive a salary, but is paid for actual services rendered of a specific character.

There is also a scientific person (Professor Faraday) permanently attached to the Trinity Board, to whom all scientific subjects are submitted for an opinion. His duties are chiefly to test, by experiment, the comparative values of the different combustible materials which are from time to time sought to be introduced into light-houses; to ascertain the best means of obtaining proper ventilation in the different light-house towers and lanterns; to decide upon the relative value of apparatus for particular light-houses; to direct the necessary means to be used to protect the towers, light-vessels, and buildings from the effects of lightning, &c.

The supplies for the Trinity House corporation are contracted for annually. These supplies are submitted to the most rigid inspection by persons competent to judge of their quality and adaptation to the purposes for which they are designed, before being received. In contracting for oil, (the best winter-strained only is used,*) the contractor

---

*Recent experiments have been made to test the practicability of using the rape-seed or colza oil.
or person offering to supply the quantity required takes samples in vials from each cask, (these vials and casks having the same marks placed upon them.) The samples are forwarded to the board. If the samples and prices are approved, the contractor is notified—the samples sent to the officer at the store charged to receive the oil. The samples and the oil in the casks bearing the same marks are compared; if the same, the oil is received, and started into the large tanks kept at the Trinity store, Blackwall, for that purpose.

The Trinity House wharf and store at Blackwall, is a general depot for all supplies for the service, from whence they are forwarded in the yachts or tenders (two of which are steamers) once a year regularly, and as much oftener as the service may require. This establishment is under the charge and control of a superintendent, (a seaman,) who receives all authorized articles for the service, and supplies all articles upon requisition. He receives the masters, mates, and crews of such of the light-vessels within the prescribed limits of the station who are employed at regular periods on shore.

In the buoy store, are kept duplicate and spare buoys, ready to be despatched instantly. In the yard, are anchors and cables for light-vessels, sinkers, and chains for buoys, spare hawse pieces for light-vessels, &c.

The first floor of the supply store is divided into rooms, each having a large supply of the different articles required in the service. The oil cellar is fitted with large tanks for oil, into which all the oil, upon its arrival, is started, and from which it is drawn into tin canisters holding about six gallons, for forwarding to the light-houses and vessels. Models for hawse pieces of the different light-vessels are kept in this store, so that new ones may be supplied without removing the vessels from their stations. All light-vessels belonging to the Trinity corporation are fitted at this depot, and a spare one always kept ready to be despatched.

The expenses of the light-house, &c., establishment, are paid out of dues collected from vessels passing the different lights, buoys, and beacons. No vessel can clear from, or enter at the custom-house, until a certificate is produced showing that all light dues have been paid. The only vessels exempt from light dues in England are those of the royal navy and revenue service, gentlemen’s yachts, and those navigating wholly in ballast.

In England the collectors of light dues are appointed by the Trinity board; all dues for Scotland and Ireland, receivable in England, are collected by these collectors. In Scotland the collectors are appointed by the board of commissioners for northern lights. They collect for England and Ireland also; and in Ireland the collectors are appointed by the ballast board of Dublin, and collect for Scotland and England.

There are many local or harbor lights in England not under the control of the Trinity corporation; although established by its consent; some of which are supported by dues collected similarly to those for coast lights, sanctioned, of course, by law; others are supported by voluntary dues collected from vessels sailing to and from the port; others are supported by the corporations to which they belong, and some by private contributions.
No new light can be established without the sanction of the Trinity House corporation. All petitions for new lights are forwarded to this board, whereupon action is had. The position of the proposed light is examined by some of the elder brethren, who are appointed to examine and report as to the utility or necessity of complying with the wishes of the petitioners. Upon the report of this special committee the board acts. If favorably, the site is finally selected; the drawings and plans made by the engineer, under instructions from the board, and contracts (the usual mode) entered into with a capable and trustworthy mechanic for the construction of the tower and other necessary buildings. These contracts are made upon specifications drawn by the engineer, under the instructions of the board, detailing in the most minute manner every part of the works to be executed. All works are executed in strict conformity to the specifications contained in the contract, under the immediate personal superintendence of some of the elder brethren detailed for the purpose, and the engineer under their orders.

The light-houses, beacons, and their appendages, in England, are constructed in the most perfect and solid manner possible. Many of the old towers are constructed of cut stone; the more modern ones almost exclusively of hard brick, the latter material being esteemed much superior to any other for land lights. Notwithstanding the cut-stone towers are in most cases lined with brick inside, as in France, yet they are damper than those constructed wholly of brick. The foundations of some of the brick towers are of cut stone laid in cement. No rubble or split stone is permitted to be used for light-house towers and beacons; and the only one that we are aware of which approaches to that kind of material is the lower portion of the North Foreland tower, (very old) which is of the flint stone peculiar to the chalk districts, laid in a mortar that is as hard as the ordinary building stone of this country. All the usual precautions have been taken to prevent dampness in this building, yet the oil cellars and lower rooms were found to be damper than most of the same parts of the other light-houses. At the same time it is but just to remark, that, while the dampness was more perceptible than in other towers, it was not so great as to produce any serious inconvenience; except, perhaps, in the supposed necessity of more frequent cleaning and painting.

The buildings are constructed and fitted up with an apparent disregard to strict economy; everything connected with them is perfect, and one cannot fail to admire the beauty and durability of the whole.

The South Foreland high light is, without exception, the finest and most perfect light-house establishment we have seen, and is certainly well worthy of imitation.

The drawings and specifications of the South Foreland high light and the Avon light, both new, with their appendages, will give a much more correct idea of these establishments than anything we could furnish descriptive of them.

The total cost of the former of these establishments, including the illuminating first-order catadioptric apparatus, constructed by M. Lepaute, in Paris, and put up by him, was £8,568.

The total cost of the Avon light-house establishment, including a
second-order lenticular apparatus, and, as in the other case, everything in perfect order and ready for lighting, was £8,572.

Although the cost of these buildings is given, it is not with the view of drawing a comparison between them and the light-house towers, &c., of other countries; for no fair comparison can be made, from the fact of their great superiority. The Trinity Board is not compelled, nor has it any object, to exercise a very strict economy in such matters. The light dues amount to much more than is required for the mere illumination of the coasts; consequently many expenses are incurred in the construction of towers and other buildings, (in the ornamental, but not in the substantial parts,) which might, under other circumstances, be avoided. It must, however, be remembered, that even in this respect there is a compensation in the increased pride felt by the keepers in their charge, and consequently the more perfect attention paid by them to all their duties.

The dwellings for the keepers are separated from the towers in most cases; and always, when it is possible to do so. The domestic fires interfere greatly with the cleanliness of the establishments.

The oil cellars are uniformly below the surface of the earth,* finished in the most perfect manner to exclude dampness, and to insure, as nearly as possible, an equal temperature during the whole year; the store-rooms for light-house stores are fitted with equal care, and with all necessary conveniences. Every precaution is taken to prevent dampness in every part of the buildings. The walls are kept well painted, and it sometimes happens that it becomes necessary to cement them. The keepers’ apartments are fitted with every regard to comfort and durability. Most of the light-house towers have been furnished with glass “lightning repellers,” but few with conductors. The matter has, however, been recently taken in hand by the board; and its scientific adviser, Mr. Faraday, and the engineer, have the further disposition of the subject.

Mr. Faraday says, in his report upon lightning-rods, for light-houses:

“That light-houses should be well defended, from the top to the bottom.”

“That as respects the top, the metal of the lantern, and upwards, is sufficient to meet every need, and satisfy every desire and fear.”

“That for the rest of the course down the tower, a copper rod three-fourths of an inch in diameter is quite and more than sufficient.”

“That glass repellers are in every case useless.”

“That glass thimbles are not needed, but do no harm.”

“That if the repeller be removed, and the point on the vane be terminated as the lightning-rods usually are, and then the metal of the lantern be strongly attached to and connected with the upper end of the copper rod, and the rod continued down the tower to the earth, and the sheet of copper buried in it, such a system will be an effectual and perfectly safe lightning conductor.”

“That then there need be no rod end rising by the side of and above the lantern.”

“That the rod may (if required on other accounts) come down on the

* There are a few unavoidable exceptions to this rule.
inside of the building, or in a groove in the wall, but should not be unnecessarily removed from observation and inspection."

"That all large metallic arrangements in the stone-work, or other non-metallic parts of the tower of the light-house, such as tying-bars, metal flues, &c., should be well connected, by copper, with the conductor."

"That the vicinity of two metallic masses, without contact or metallic communication, is to be avoided."

"That as to the South Foreland high light, the lantern, the central stone, and the copper rod proceeding from it to the earth, connected as they now are, form a perfect conductor, even without the rod that is there erected;" but

"That it is important that casual arrangements should never be depended upon for lightning conductors, but a copper rod be established for the especial purpose; for if the former be trusted to, the carelessness or ignorance of workmen may, at after periods, upon occasions of repair or cleansing, cause the necessary metallic connection to be left imperfect or incomplete; and then the arrangement is not merely useless, but dangerous."

* * * *

The light-house constructed upon the Maplin sands, (upon screw piles,) on the principle of Mr. Alexander Mitchell, is the only one of that kind belonging to the Trinity House corporation at present. This light is near the entrance of the Thames, the foundation of which was made by Mr. Mitchell and his son in 1838; shortly after which, the Trinity Board directed their engineer (Mr. Walker) to take charge of and complete the works. This light-house was completed and lighted in February, 1841; since which time it has stood well, and answered, in every respect, the sanguine expectations of Mr. Mitchell and his friends.

Another light, somewhat similar, was afterwards erected by Mr. Walker at the Point of Ayr, near Liverpool. This light is placed upon the end of a long sand spit, which is bare at low water. The foundation was laid at low water by welling out, to a sufficient width and depth to admit the iron cylinders, (nine in number,) into which iron piles were placed; the space between the iron piles and the interior of the cylinders being filled with concrete. The light-house has been up for nearly four, and lighted more than two years. It stands well; shakes occasionally, but does not sink or change its position. No particular advantages are claimed for this peculiar mode of construction—at least in comparison to the plan of Mr. Mitchell.

Mr. Mitchell erected another screw-pile light-house in England in 1839, which has stood the test of all weather since that time, and has succeeded, in every respect, to the admiration of all persons interested in such valuable improvements. This light was erected for the Fleetwood Harbor and Dock Company, at the mouth of the Wyre, in Morecombe bay, where the tide occasionally rises thirty-two feet.* The work was commenced in November, 1839; and after waiting sometime for the

* For details, refer to Denham's guide to the river Mersey, and the light-house report of 1845.
dioptic (second order) apparatus from Paris, it was completed and lighted, for the first time, on the 6th June, 1840. The whole cost of this establishment was £3,500, and kept up at an annual expense of £335; consuming about 420 gallons of the best sperm oil. No expenses have been incurred for repairs since its erection, except for paint. The light is elevated 28 feet above the ordinary tides.

Messrs. Mitchell & Son hold the following language in a communication from them to the Trinity Board, dated July 8, 1845:

"Permit us again, most respectfully, to solicit your attention to the subject of our patent screw piles, by means of which, and by those means alone, foundations have been laid in sand banks covered at all times by the sea, and on which light-houses have been erected which have now endured, uninjured, the storms and casualties of many winters. The foundation of the Maplin light-house was laid seven years since, namely, in the summer of 1838; and the Fleetwood light-house, which was commenced in the summer of 1839, was lighted on the 6th June, 1840, upwards of five years since: since which time, with the exception of a little paint, we understood that neither house has required the smallest repair. A third light-house was last season erected by us in Carrickfergus bay, where the depth of water is never less than ten feet; this house serves also the purpose of a pilot station, twelve or more men being generally residing in it, and it having two pilot boats suspended to it in tempestuous weather."

"A beacon of a peculiar construction was placed by us, above two years ago, on the Kish bank, where the depth of water is never less than 15 feet." "This beacon, besides great economy and strength, possesses many other important qualities; it now remains as we left it, and there we hope to complete next season a light-house constructed principally of wrought iron." "The above statement of facts we presume sufficiently proves the power and efficiency of a principle to the perfecting of which we have devoted many years; and, observing the well-merited encouragement given at present to others who propose to effect the same important objects by other means, we would most respectfully solicit the favor of an audience, when we trust to be able to submit to your honorable board certain proposals which may to some extent merit your countenance and support." * * *

"We will undertake to mark off any banks or channels in the estuary of the Thames, or its neighborhood, with beacons of the description of that placed by us two years since in the Kish bank, and those we are preparing to place in the Blackwater and Arklow banks." "We will prepare and place any number of such beacons, at our sole expense and risk, in any position where the depth does not exceed three fathoms at low water, for the sum of £500 each; such payment not to be due for any beacon till it has securely stood the test of one winter."

"For such beacons as may be required when the depth of water exceeds the above-named three fathoms, a price proportional would be necessary to cover the increased expense." "We have only to add, that these beacons and light-houses are so constructed as to be easily taken asunder and removed to other positions, should any shifting of banks or channels render such a measure expedient."
Mr. Mitchell estimates that a screw-pile light-house may be erected out of the best materials, (hammered iron, &c.,) including the illuminating apparatus, lantern, &c., complete, in any place now occupied by a light-vessel, for £10,000, including those placed to mark the Goodwin sands.

Light-houses of cast-iron are being introduced gradually. Two towers of this description have been recently erected; one at Morant point, Jamaica, 101 feet 6 inches from the ground to the top of the lantern, at a cost, including lantern and lighting apparatus complete, of about £4,100; the other for the island of Bermuda, to be fitted with a first-order lenticular apparatus, at a total cost of about £5,500. A third is under contract for Point de Galle, Ceylon, to be executed by the same individual, (Mr. Alexander Gordon, civil engineer.) The chief alleged advantages of the cast-iron over the stone and brick towers are these: cheapness, facility of erection in any place, greater strength against vibrations in hurricanes, freedom from injury by lightning in tropical climates, and against the chances of earthquakes or fire.

The Trinity Board has given some encouragement to Doctor Potts, who has succeeded in sinking, by atmospheric pressure, hollow tubes of iron a considerable distance into the ground. This mode of laying foundations for light-houses, as substitutes for light-vessels and for beacons in certain locations, has met with several advocates; among others the deputy master of the Trinity Board, Mr. Alexander Gordon, civil engineer, &c.

A cylinder of iron 30 inches in diameter has been forced (upon the plan of Doctor Potts) 23 feet into the ground, in which there was much gravel, at the Trinity House wharf, Blackwall, and another, of the same diameter, 33½ feet in the Goodwin sands; the latter in 5½ hours' working time.

Annual repairs are made by contract upon competition tenders, intrusted invariably to the direction of the engineer of the board, and executed under the personal inspection of one of his clerks of works. In the early part of every year, it is usual for the Trinity Board to address a circular letter to each of the district superintendents or local agents, as the case may be, directing them to make a careful examination of the premises under their charge, and report what may be considered necessary to be done for keeping them in a proper condition for the current year, distinguishing ordinary from extraordinary works. These reports are submitted to the Committee on Lights. Extracts are made from them, which are presented to the board. The usual course then is to refer these reports to a joint committee, composed of the deputy master and wardens, and the Light Committee, to consider collectively which of those works shall or shall not be executed. The more important works recommended are never determined upon unless upon the special report of a visiting committee of the elder brethren, nor is such committee permitted to direct the execution of any such works until after those recommendations shall have been carefully considered and approved by the board. For annual amount of repairs of the lights under the control of the Trinity House corporation, refer to the report of the select committee on light-houses of the English House of Commons, 1845.
There were in England in 1845, under the control and management of the Trinity House corporation, Deptford Strond, as follows, viz:

50 public general or coast light-houses, fitted with catoptric apparatus, containing 674 burners................. 674
11 catadioptric and dioptric lights of the first order, estimated at 14 burners each............................................ 154
5 catadioptric and dioptric lights of the second order, estimated at 9 burners each................................... 45
25 floating lights, containing.................................. 288

Making a total of 91 lights, and burners..................... 1,161

An increase, since 1834, of 33 lights, including purchases and transfers from other bodies, and containing 439 burners. Of this increase, up to 1843, eighteen are new lights. There were also at the same period, in England, 75 harbor or local lights, over which the Trinity Board exercises a general supervision.

Prior to 1836, there were no lights in England, belonging to the Trinity House corporation, fitted with lenticular apparatus upon the principle of Fresnel, but since that period, no less than sixteen establishments have been supplied with that apparatus, a list of which is given, as follows:

Light-houses having the lenticular apparatus of Fresnel.

<table>
<thead>
<tr>
<th>Start</th>
<th>1st order</th>
<th>1836</th>
<th>Revolving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menai</td>
<td>Do</td>
<td>1838</td>
<td>Do.</td>
</tr>
<tr>
<td>Bardsey</td>
<td>Do</td>
<td>1838</td>
<td>Do.</td>
</tr>
<tr>
<td>Flatholm</td>
<td>Do</td>
<td>1839</td>
<td>Do.</td>
</tr>
<tr>
<td>St. Catherines</td>
<td>Do</td>
<td>1840</td>
<td>Do.</td>
</tr>
<tr>
<td>Hunstanton</td>
<td>2d order</td>
<td>1840</td>
<td>Do.</td>
</tr>
<tr>
<td>Avon</td>
<td>Do</td>
<td>1840</td>
<td>Do.</td>
</tr>
<tr>
<td>Maplin sand</td>
<td>Do</td>
<td>1841</td>
<td>Do.</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>1st order</td>
<td>1841</td>
<td>Do.</td>
</tr>
<tr>
<td>Coquet</td>
<td>Do</td>
<td>1841</td>
<td>Do.</td>
</tr>
<tr>
<td>Lundy</td>
<td>Do</td>
<td>1842</td>
<td>Revolving.</td>
</tr>
<tr>
<td>South Foreland, (high)</td>
<td>Do</td>
<td>1843</td>
<td>Fixed.</td>
</tr>
<tr>
<td>Plymouth breakwater</td>
<td>2d order</td>
<td>1844</td>
<td>Do.</td>
</tr>
<tr>
<td>Skerries</td>
<td>1st order</td>
<td>1844</td>
<td>Do.</td>
</tr>
<tr>
<td>Eddystone</td>
<td>2d order</td>
<td>1845</td>
<td>Do.</td>
</tr>
</tbody>
</table>

Some of the first lenses that were introduced into the light-houses of Great Britain were constructed by Mr. Cookson, the distinguished glass manufacturer of Newcastle-upon-Tyne; but the early discovery of the fact that the French glass was greatly superior to any he could make for that special purpose, the rapid advancement which was daily being made by the French artists in Paris towards the perfecting of this invaluable invention, and the difficulty and expense attending the manufacture of the various combinations of the lens, induced or compelled him to abandon a most laudable undertaking, one worthy of a better success. They are now executed exclusively in Paris by Messrs. Letourneau & Co., successors to M. Soleil, sr., and François, jr., and M. Henry Lepeute.
A number of harbor or local lights, which have been recently established in England, have been fitted with the lens apparatus; for example, at Ramsgate, Cardiff, mouth of the Wyre, &c.

The lights belonging to the Trinity corporation are distinguished as fixed, revolving, flashing, colored; and double lights in some instances, by placing two towers near each other. Red is the only color used for distinguishing lights, except in a single instance, and that a green one on the pier head at Brighton.

The number of burners in each light-house varies from one to thirty, although there are very few with a less number than ten.

The reflectors are of the parabolic form, generally of 21 inches diameter, and the most of them made by Messrs. Wilkins & Son, of 24 Long Acre, London.

Messrs. Wilkins & Son have succeeded in getting their pneumatic and hydraulic lamps introduced into some of the English lenticular lights, ostensibly with the view of obviating alleged difficulties which present themselves in the management of the Carcel or French mechanical lamp, in common use in the light-houses of France, and other parts of the world where the lens apparatus has been introduced. We mention the fact here of these lamps being employed in some of the lens light-houses in England, simply because such is the fact, not to express a favorable opinion of them; on the contrary, we cannot see any good and substantial reason for objecting to the employment of the French mechanical lamp, (for light-houses,) as at present constructed in Paris.

The pneumatic lamps, manufactured by Messrs. Wilkins & Son, London, are considered by them less liable to derangement and less difficult to attend to than the French mechanical lamps, used for the illumination of the lenticular lights; being placed in the same manner that the French lights are, they can be employed for apparatus which are required to illuminate the whole extent of the horizon; for apparatus with a break in the illumination, requiring four-fifths or three-fourths of the horizon only to be illuminated, another lamp manufactured by the same persons is recommended, which they call the hydraulic or fountain lamp. The keeper of the light-house of St. Catherines, Isle of Wight, disapproved in the most decided terms of the pneumatic lamp, to which he had given a fair trial for two years in the light-house under his direction, but approved of the hydraulic one sent to take its place. This latter lamp has been used successfully at the Flatholm light-house since March, 1839, and at Caysal banks, Bahamas, since January, 1839, besides at various other places; and they say no fault has been found with them so far. These manufacturers have produced a lamp to be used with reflectors, with which they propose to burn cheaper oils than sperm, which they call their “catoptric lamp.” Experiments have been made recently, by order of the Trinity Board, to test the alleged superiority of this lamp to the Argand in common use; no decision has been made known upon the subject.

The manufacturers have succeeded in introducing them into eleven light-houses since 1840, but no reports have been made, either favorable or unfavorable to them. The lanterns and lighting apparatus are constructed with the same regard to stability and durability as in the con-
struction and fitments of the buildings; the frames for the lamps and reflectors are of iron, very solidly fitted together, and the lamps and reflectors so securely placed that it would be almost impossible to get them out of their proper positions; the light-rooms are large, and of good height; the glazing is ordinarily of thick plate glass of 30 inches broad to 24 inches high, set into composition metal frames, and the roof of the lanterns of copper. The light-rooms and domes of the lanterns are painted white, and they retain their cleanly appearance, by care and an occasional application of soap and water, for a considerable length of time; the lanterns are free from smoke, notwithstanding the different methods that are employed to produce a proper ventilation.

Particular attention is bestowed upon the ventilation of the towers and lanterns. Professor Faraday has recommended a method for ventilating the English light-houses which is very highly approved of, and has already been introduced into many of the light-houses; it consists (for reflector lights) of a number of tubes of metal, which receive the smoke just within the glass chimneys, and transmit it into a copper ball or globe, in the centre and upper part of the lantern, thence through the dome of the lantern by means of an ordinary communication, exteriorly fitted with a weathercock. The chimneys for lenticular lights are constructed with joints or openings, and furnished with dampers, so that the draught may be increased or diminished without difficulty.

There are ventilators around the lower part of the light-rooms, which are regulated by the keepers, by closing them on the weather and opening them on the lee side, the number kept open depending entirely upon circumstances, the keepers being guided by the burning of the lights, in a greater or lesser degree.

The material for burning in the English light-houses is pure "winter bagged sperm oil." The results of experiments to test the value of different gases for light-houses purposes have not been satisfactory to the Trinity Board, or sufficiently so to warrant their introduction into any of the light-houses under its control. They regard the sperm oil, or refined rape-seed (colza) oil, as preferable materials; the latter is the cheaper in England; it has not, however, been generally introduced. In fact, the determination to use it at all is of very recent date.

No experiments have been made recently in England upon the Drummond, Bude, Gurney, galvanic, or other lights of that character, with reference to their being applied to light-house purposes.

Gas is used in several of the local lights in England, which are not under the management of the Trinity corporation, with considerable success. It is made of different materials, but chiefly of coal and oil, and is generally furnished from an establishment of some town, or from one employed to make gas for the docks in the vicinity of the light-house. At Holyhead, for example, there is a light-house on the end of the pier with twenty burners; also, in the same tower, below the principal light, a small red light with a single burner. The expense of this establishment is reported to be £550 per annum, which includes the lighting of about three quarters of a mile of road along the harbor. All the lamps are supplied from the same gasometer.* Although gas

* Oil gas.
is used with success in some instances, and gives a very brilliant light, yet it must not be forgotten that accidents have occurred in its use, and those of a most serious and fatal character. There are reasons, also, for not employing it in coast lights, which do not apply so strongly to harbor or inland lights; such as the distance from any means of repair, should an accident occur, and the great mischief that might be done by the discontinuance of a sea-coast light, even for a very short space of time.

The average prices of best sperm oil in England have been, since 1834, from five shillings to eight shillings and fourpence. In 1845 the Trinity contracted for two hundred tons, at six shillings and eightpence per imperial gallon, while in France the best colza oil was worth only three and eightpence; it is asserted, however, that the lamps consume more of the colza or common oil than of sperm.

The Messrs. Wilkins state that their catoptric lamp consumes a pint of rape-seed oil in twelve hours.

There are gas lights at Avon, Seaham, Workington, &c., under local authorities.

Arrangements for securing the necessary attendance upon the lights, their expense and efficiency.

The shore lights have two keepers, one principal and one assistant, except at stations where two lights are sufficiently near each other to admit of relief, in which cases they employ one principal and two assistant keepers. Every rock, or isolated light-house, is allowed three keepers, one principal and two assistants. The instructions to the light-keepers (hereto annexed) are full and explicit. It will be seen by a reference to them that the keepers retain their places so long as their conduct meets the approbation of the Trinity Board, and they receive promotion for their faithfulness as vacancies occur. In many cases they have been in the employment of the corporation for thirty and thirty-five years; succeeding, in some cases, their fathers, who probably received their charge in the same way. The keepers, generally, seemed to be well acquainted with their particular duties, and gave unquestionable evidence that they discharge them most faithfully; but in no other respect could they be considered remarkable as compared with persons filling similar stations in other countries. There were, in 1845, 123 light-keepers belonging to the Trinity House corporation—53 principal and 70 assistant keepers. The ordinary salary of a principal light-keeper is £65, or about $81.5, and that of an assistant £45, or about $21.5. There are, however, numerous exceptions to the rule: for example, there are 19 stations at which the principal keepers receive from £70 to £100, or from about $340 to $490, including victualling allowances, but not clothing, of which latter each person receives once in three years a suit of uniform and a watch cloak. The majority of the Trinity light-houses are supplied with a timepiece, (generally a good clock,) a barometer, thermometer, hygrometer, a blank meteorological journal, and forms for copying it in the shape of a report; a journal for the remarks of visiting agents and other persons, (all visitors being re-
quested to write their names and make such remarks as they may think proper; forms for monthly returns of the expenditures of oil, embracing each day of the month; and also forms for quarterly returns of all other stores. Those in charge of lenticular lights are furnished with special instructions for the management of the mechanical, hydraulic, or pneumatic lamp, as the case may be.

The harbor lights, with few exceptions, are furnished with self-regulating tide gauges, but especially those placed to mark the channels leading to artificial harbors, the ability to enter which, depending upon the state of the tide.

There are eighteen local agents, having charge of from 1 to 3 light-houses and a few buoys and beacons each, receiving salaries ranging from £20 to £75 per annum. There are also eight sub-agents, or keepers of buoys and beacons, in charge of from 1 to 28 each, receiving salaries at the rate of from £10 to £50 per annum.

There are seven district superintendents, having charge of from 7 to 16 light-houses, 1 to 8 light-vessels, 7 to 90 buoys, and from 4 to 15 beacons, who receive salaries ranging from £130 to £450 per annum.

An agent or district superintendent, in visiting the establishments under his charge, notes, in a journal kept for the purpose, whether or not he finds everything in a satisfactory condition. The journals are transmitted to the board, with the reports required of them and of the keepers, periodically.

Inspections are also made by a committee of elder brethren, which makes its visits as frequently as may be deemed necessary to insure a strict performance of all the duties required of the keepers, and its reports, embracing all matters pertinent to the subject, are made to the board for its action.

The system of local agencies is being changed gradually, and the system of district superintendents substituted for it, which is considered to be far more advantageous to the interests of both navigation and the light-house establishment, than the former.

Although the management of the Trinity House lights is considered by Captain Washington, of the royal navy, (and who in the course of his duties has had ample means of judging,) very efficient; yet he thinks the district superintendents and agents are not selected generally from the proper class of persons. He says, in reply to the question, that "lieutenants and masters in the navy" are the proper persons to have the important duty of agents to superintend the lights.

Captain Washington was asked, "Why do you consider them preferable to engineer officers or scientific men of that class?" "Because no one but a sailor can be a proper judge of where a buoy, or a beacon, or a light-vessel, ought to be placed."

"They should also have the general superintendence of all the district light establishments."

Question. "Then it is your opinion that the whole coast of the United Kingdom should be divided into districts, in each of which an officer responsible to the admiralty should have the superintendence of both buoys and lights?" "Undoubtedly; nothing would tend more to the interests of navigation."
Captain Washington says further, in regard to the management of the Trinity light-houses, "but I think that if a properly selected small body of men, under government, were appointed to manage the whole of their affairs, a very great saving of expense would accrue, and I think the general management would be much better." "I may add that that body, perhaps, should consist of two captains in the navy, two masters of merchant ships, and the hydrographer, with power to call in a first-rate chemist, an optician, or an engineer, whenever they require their services; but I do not think it necessary that such men should form part of the permanent board, my opinion being very distinct that no persons but sailors can know where properly to place light-houses, light-vessels, buoys, or beacons." "I am aware that Captain Love (R. N.) has been recently appointed district agent of the south coast of England, and I rejoice heartily at it, for it is what I have been always recommending should be the case upon all the coasts of Great Britain; only I think an officer of lower rank would be more appropriate for the station." "I am of opinion that, with the exception of Captain Love at the Isle of Wight, they (the agents) are not selected from the class of men most fitted for such duties; and the immense value of keeping our masters well acquainted with the buoys and lights must be evident to every one;" * * * "besides, I think a lieutenant much better fitted for the duty.'

Question. "Do you think the system (the employment of lieutenants and masters in the navy for agents and superintendents) would work better for the country?"

"I have no doubt of it, in every respect; sooner or later we must come to it."

There are twenty-five floating lights belonging to the Trinity House corporation, the number of burners varying from 4 to 24 in each vessel; they are distinguished at night by having lights on one, two, or three of the masts, red or white lights, and revolving. In the day they are distinguished by having the names painted in large letters on the sides, different colors of the hulls of the vessels, balls on the masts, &c.

These vessels are of from 150 to 180 tons, constructed of wood, and well found in every respect; they are generally moored by heavy mushroom anchors, with spans and bridles. The crews, with one exception, consist of eleven persons—one master, one mate, two lamplighters, and seven seamen. In the case of the exception there are eleven seamen. Two-thirds of the crew are always on duty on board of the vessel with the master or mate; the other third are employed at the station nearest to the superintendent, so that the vessel employed in executing his duties afloat is manned by that portion of the crew off duty from the light-vessel. There is one master and one mate for each vessel, so that there are 25 of each. The masters receive an annual salary of £60, and £20 more for house rent; they also receive an allowance of one shilling and sixpence per day for victualling, equal to about thirty-five cents. The mates receive an annual salary of £48 per annum, and the same allowance for victualling; the master and mate receive each a suit of uniform clothing. The men receive 45 shillings per month, and one shilling and threepence per day, when on shore, for victualling. The wages are paid
while employed on shore, the same as when on board. When afloat, they are provisioned by the master with the following rations, viz:

- Meat, 10 pounds per week each man.
- Bread, 7 pounds do. do.
- Flour, 2 pounds do. do.
- Peas, 1 pint do. do.
- Potatoes, 7 pounds do. do.
- Suet, 3/4 pound do. do.
- Tea, 2 ounces do. do.
- Sugar, 3/4 pound do. do.
- Beer, 3 gallons do. do.

A copy of the regulation is fixed up in the cabin, and at the galley of each vessel, and none of the provisions are permitted to be removed from the vessel.

The men are selected from the merchant sea service by the committee for lights, and the master and matey by the deputy master and wardens, from those who have passed through the grades of seamen and lamp-lighters in the Trinity service. A few select books are supplied to each vessel for the use of the officers and crew.

The agent residing on shore in the vicinity of the light-vessel is required to ascertain, every evening and morning, as far as possible, if the vessel is in her proper position.

A spare light-vessel is kept always in readiness at the Trinity House wharf, Blackwall, and another at Yarmouth, to take the place of any that may be driven from their moorings, or disabled. The instructions to the masters of light-vessels are appended to this report.

The light-vessels are inspected by the agents and committees of the elder brethren; by the former when they take supplies or relieve the crews. The lowest charge for the maintenance of any light-vessel belonging to the Trinity corporation, in 1843, was £714 15s. 4d., or about $3,400; and the highest was £2,380 10s. 2d., or about $11,500. The average cost for maintaining the 28 floating lights for that year was, including all the ordinary repairs, provisions, &c., £1,251 5s. 2d., or about $6,000 for each. For all the details relating to the expense of maintenance of the Trinity lights for the year 1843, refer to the report of the select committee of the House of Commons of Great Britain, 1845.

All the Trinity light-vessels are furnished with gongs instead of bells, for foggy weather, and they have been found to answer admirably, there being no danger of their being mistaken for vessels' bells. In his evidence before the select committee on light-houses, referred to above, Captain Washington, royal navy and admiralty surveyor, advocates the substitution of fixed light-houses, upon the plan of Mr. Mitchell, in the place of light-vessels. He says, with reference to the Cocklegat light-vessel: "The Maplin light is so erected, (upon Mitchell's screw piles,) and of course all fixed lights are far better than floating lights; and although the depth of water is three fathoms, I am of opinion there would be no insurmountable difficulty in so placing it."

The Trinity corporation has manifested a disposition to introduce
such structures, as is evident from the encouragement given to Doctor Potts, by authorizing experiments to be made with his cylinders; and to Mr. Mitchell, by entering into several contracts with him for foundations on his screw piles.

Captain Washington attributes the difficulty of keeping the light-vessels in their places to the fact of the cables by which they are moored having undergone too severe a test; it having been ascertained that cables, after having been put to the admiralty test, would not, upon a second trial, bear more than one-half the strain they did at first.

There are 299 buoys and 48 beacons under the Trinity corporation on the coasts of England, which are supported by a charge upon the merchant shipping, as in the case of the lights. They are under the immediate control and management of the elder brethren; are distinctly marked, and kept well painted in different colors. They are distinguished by their size, shape, colors, and at turning points, &c., by perches placed upon them. The system of having all the buoys of the same color placed on the same side of the main channels leading to harbors, is strictly adhered to throughout the whole coast.

The buoys are of wood—some hooped with galvanized iron, which effectually prevents rust; are changed twice a year, repaired, and painted; at the same time their moorings are examined, and, if deemed necessary, changed also. Ordinary moorings consist of heavy blocks of stone secured to the condemned chains of the light-vessels. Captain Washington says: "I am aware that the Trinity Board, within the last ten years, since the last House of Commons committee on light-houses, have done a very great deal towards the improvement of lightage; but I think the buoying of our coasts is still far from an efficient state."

The inspections of the buoys, beacons, &c., are made by the agents and elder brethren, in the manner prescribed for the lights. Information of a change or loss of a buoy is almost instantly communicated to the Trinity Board by the pilots or coast guard; and others being kept always ready for replacing them, very little time elapses ordinarily before the danger is properly marked. The agents are supplied with buoys for wrecks, which are painted green. They are also authorized to place buoys upon any newly-discovered danger or obstruction to navigation, marked "dangerous," in large letters.

Captain Washington insists that none but thorough-bred seamen can properly place light-vessels and buoys, and that they should be replaced by measuring the angles between three well-established points on shore.

The local authorities who have charge of harbor and river buoys frequently employ for the larger moorings the screw invented by Mr. Alexander Mitchell, similar to that used for the light-house pile.

In every instance in which this mode of mooring buoys has been tried, it has answered to the entire satisfaction of those interested in the navigation of those localities. These moorings have been put down in various harbors and rivers of Great Britain, but a larger number in the Clyde, Tyne, and Dublin harbor, than elsewhere. During the past summer of 1845, Mr. Mitchell contracted with the Trinity corporation of Newcastle-upon-Tyne for placing about one hundred buoys between that town and the sea, or Shields. They are the only moorings yet discovered by
which to obviate all the difficulties of the navigation of the Tyne, owing to the strong tides, and the great numbers of vessels lading and discharging at all seasons.

For ordinary channel buoys, these moorings would seem to be too expensive; but for moorings for heavy buoys in a tideway, for vessels to ride by, and for those marking very important points in intricate channels, which are liable to be dragged from their proper positions by malicious persons making fast their vessels to them, as has been reported to have occurred at the entrances to some of our harbors, the employment of them would, without doubt, be attended with results advantageous to the interests of commerce. The whole cost of each of these moorings, properly put down by the patentee or his son, is about £50.


<table>
<thead>
<tr>
<th>Years</th>
<th>Number of light-houses</th>
<th>Number of burners</th>
<th>Average burners in tower</th>
<th>Average cost per burner</th>
<th>Average cost per light-house</th>
</tr>
</thead>
<tbody>
<tr>
<td>England, general coast</td>
<td>1843</td>
<td>67</td>
<td>864</td>
<td>13</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>Scotland, general coast</td>
<td>1843</td>
<td>26</td>
<td>456</td>
<td>17½</td>
<td>31 14 6</td>
</tr>
<tr>
<td>Ireland, general coast</td>
<td>1844</td>
<td>27</td>
<td>540</td>
<td>20</td>
<td>23 13 0</td>
</tr>
<tr>
<td>Ireland, harbor lights</td>
<td>1844</td>
<td>29</td>
<td>216</td>
<td>7½</td>
<td>26 4 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>149</td>
<td>2,076</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THE HARBOR OF LIVERPOOL.

LIGHT-HOUSES, FLOATING LIGHTS, BUOYS, BEACONS, ETC.

It has been already stated that in England many of the lights and lighting establishments are under the direction and management of local authorities; among others of that class is the one belonging to the port and harbor of Liverpool. It does not appear to be necessary to speak of more than one of these establishments in detail, to show the manner in which the trust is generally executed. We shall, therefore, in this respect, confine ourselves particularly to that in which the facilities afforded us for examinations were the greatest, and which presents, doubtless, as fair and proper an example for imitation as could be selected.

No harbor could surpass that of Liverpool in the beauty and efficiency of the arrangements of lights, buoys, and beacons; yet, notwithstanding the apparent perfection of all the arrangements in every branch of the establishment, the active and intelligent marine surveyor of the port is far from resting satisfied with the results of his indefatigable exertions, and no opportunity for improvements is allowed to pass by unheeded. Soundings are frequently taken in intricate channels; gradual alterations of
banks, bars, and channels watched with the care and attention due to such important matters; and the necessary changes of the places of buoys, beacons, leading marks, &c., made from time to time, in accordance with the interests of the commerce of the port.

The establishment having charge of all the light-houses, floating lights, beacons, buoys, life-boats, &c., is under the control of the "committee for the management of the estate of the Liverpool docks." A sub-committee and the marine surveyor of the port of Liverpool (a lieutenant in the royal navy) have the undivided charge and management of the lights, beacons, buoys, &c., and all matters appertaining to them. The marine surveyor is allowed an assistant, (a master in the royal navy,) who attends to the placing the buoys, inspection of lights, supplies, &c., under the direction and immediate orders of the surveyor.

There are seven light-houses under the control of this corporation.

There are three riding light-vessels, viz:
Northwest light-ship, fixed light, 24 burners.
Formby light-ship, fixed light, 16 burners.
Crosby light-ship, fixed light, 8 burners.

There are, also, about sixty buoys in use; about ten land beacons; one floating bell beacon in use, and another always kept ready to take its place; two spare light-vessels ready for service, to replace those at their stations—(one kept riding in the stream, and the other in dock;) and a number of spare and duplicate buoys ready for instant service.

All supplies are procured on tenders, and are delivered at the storehouse, from which they are forwarded by the yacht to the several light-stations and vessels.

Nothing but the best winter-strained sperm oil is allowed to be used in the lights of this corporation, which is received only after having been subjected to the severest tests by the surveyor. The tests are, burning it in the usual manner, without trimming the lamp, by its specific gravity, and by the intensity of light produced by it.

The vessel employed as a tender performs, also, the duties of removing, placing, and replacing buoys, &c.

The Rock light-house, placed at the entrance to the river Mersey, is constructed of a grayish-colored limestone, in the shape of a beautifully-proportioned bell. The base of the tower is surrounded by water at one-third tide; its lantern is 77 feet above the ordinary high tides, having a range of 10½ miles of horizon, but can be seen 14 miles from the deck of a ship. It exhibits a red and white revolving light. On one side of the frame there are ten 21-inch parabolic reflectors with Argand lamps and burners, with red glass chimneys. On each of the other two sides of the frame are six similar reflectors, lamps, and burners, with white chimneys. The white light produced by the six lamps and reflectors is apparently as intense as that produced by the ten lamps and reflectors with red chimneys.

From a chamber, half way from the base of the tower, a bright fixed light is exhibited down the Rock channel and up the Mersey, when there are twelve feet of water on the Rock-gut bar, and continued so long as there is that depth of water there. The signal during the day, indicating the same, is a black ball hoisted above the balcony of the tower. On
the edge of the balcony are three fog-bells of different sizes and tones, which are struck by the hammers being put in motion by the revolution of the machinery of the light, extra weights being applied when geared for that purpose. A blue flag hoisted on the tower indicates the necessity of sending out the life-boat. The keepers are supplied with life-preservers, cords, &c., which are kept ready at hand to throw to persons or boats that may arrive within reach of such aid.

For the purpose of affording speedy and efficient relief to vessels in distress, the chart of Liverpool bay is divided into squares, each square bearing a number. These charts are furnished to each light-vessel, light-house, and telegraphic station. A vessel grounding, or needing assistance from any other cause, is immediately telegraphed, designating the number of the square in which the vessel is. The surveyor, glancing his eye upon the chart, sees at once the position of the vessel in distress, judges what her probable wants are from his knowledge of the dangers near her, provides for them, and despatches the steamer directly for the position indicated, by the nearest available channel.

The Point Lynas light-house stands on the northeastern promontory of Anglesea. It is a castle-like building, with a square tower of stone, the basement of which is painted white. This is also the pilot station.

The light is flashing. It is visible only without the range of dangers surrounding the point. The flashes are made by the opening and closing of a series of boards placed before the lamps and reflectors, somewhat like the ordinary Venetian blinds, only broader. The effect is perfect, and the plan an ingenious one. The top of the lantern is glass, through which the light can be seen at a short distance during the periods of eclipse. The distance to which the light can be seen in full strength is from eighteen to twenty miles. The other light-house towers are of different materials—wood, stone, and brick—colored to attract the eye and designate them by day. The lights are masked in certain directions, pointing out, by the coming in view or the disappearance of the light, a turning point or danger. The system will be more clearly understood by a reference to the chart of Liverpool harbor. The plan of masking the lights as exhibited in the Bay of Liverpool produces a most beautiful effect, and renders the otherwise difficult and intricate channels so plain that strangers have been known to run their ships up to the docks without pilots, relying entirely upon the sailing directions.

The lights are inspected monthly by the surveyor of the port. Printed instructions are supplied to all the establishments, all differing in some minor respects.

The beacons are constructed of different materials and in different shapes. By reference to the chart, it will be perceived with how much attention and care the beacons have been placed to answer as guides into the intricate channels.

The light-vessels are constructed of wood, with one exception. They exhibit three, two, or one light; the lanterns are hoisted around the masts at different heights; the rigging is of iron wire, and well protected. Two of the vessels are placed in the turning points of the Crosby channel, and the other (the northwest light-ship) is the outer one of all, and may be considered the key to the harbor. It is the largest (200 tons)
built of iron; has three lanterns, with eight lamps and twenty-one inch reflectors in each; (the lights are visible ten miles in good weather;) rides well at her moorings, and is considered a far superior vessel to those constructed of wood. In addition to the three lights, a blue light is burnt every two hours, and in foggy weather the gong is sounded and the bell rung alternately, and the mizen lantern lowered to the rail. Signals are supplied to this vessel, by which assistance may be called for any vessel needing it.

The light-vessels are all distinguished by being painted differently; by balls, grating work, &c., of different colors, and by their names being painted in large letters on their sides.

These vessels are extremely well found in all respects; are moored with the stream, with heavy double-armed anchors and about 100 fathoms of 1½-inch chain on each anchor, brought to a swivel. The chains are fitted with wrought-iron studs instead of cast-iron ones, and are tested by the company; they are required to be able to sustain a degree of tension equal to 49 tons weight before they are accepted. The moorings are examined every week by heaving in a portion of the chain attached to each anchor; the anchors are lifted once a year, (generally in August,) and the working part of the chain renewed. As these vessels are leading marks for a narrow channel, they are not permitted to veer cable; they are allowed a spare anchor and cable for bringing the vessel up in the event of parting the moorings. Should they, by any accident, get out of their stations, the lights are immediately extinguished, and the balls and other distinguishing marks taken down. Captain Washington (R. N.) recommends that these vessels should be moored with three anchors and equal lengths of cable, the vessel riding at the centre of their junction.

The light-vessels are visited and inspected twice a month by the marine surveyor of the port, and every two years they are brought in for a general overhaul and repair, some of the spare vessels supplying their places for the time. The masters and crews are relieved in the same manner that those attached to the Trinity light-vessels are, and, when thus relieved, perform duty in the yacht when required.

For expenses of light-vessels, number of men employed, &c., refer to the tables hereto annexed; refer, also, to the printed instructions for the masters and crew of those vessels.

The bell beacon (see the accompanying drawing) placed at the entrance to the Victoria channel is of iron. This beacon answers admirably the purpose for which it was intended; the bell (24 cwt.) is on a mast, stepped in a boat-shaped hull, decked over, drawing three feet water, and heavily ballasted. From the peculiar construction of this vessel, the motion of the little sea where she is moored is quite sufficient to put the four hammers in play upon the bell, the sounds of which may be heard distinctly from four to six miles, sufficiently far to apprise the navigator of approaching dangers. There is a duplicate bell beacon, which is kept ready for instant service.

The buoys are constructed of both wood and iron. Those of iron are being pretty generally introduced by the surveyor. Six of the largest employed are of that material, and he expresses a decided preference
for them, both in an economical point of view and as a matter of expediency. They are constructed with water-tight compartments, so that there is no danger of their filling should they be injured by a vessel coming in contact with them. Galvanized iron, both for buoys and for the hoops of wood ones, is highly approved of. The expense is the great obstacle. For buoys to be painted white, there can be little doubt of the great advantage of using the galvanized iron for hoops. Can and nun buoys are employed. (See accompanying drawings.) The iron buoys require a weight to each to make them float properly in the water; but, once properly ballasted, there is no further difficulty with them in that respect. The buoys are of good sizes, fine proportions, and are distinguished by their color, shape, number, and name.* Here, as in all the ports of the kingdom, red buoys are placed on the starboard hand of the channels leading from seaward, and the black ones on the port hand. The numbers commence from seaward. At the end of spits, or at turning points, perches are placed on the buoys (of iron.) So well and perfectly are the buoys distinguished, that a man, to go wrong, must be unable to read, or to distinguish colors.

The moorings of the buoys are heavy iron sinkers, so moulded as to increase their tenacity of hold, with the heavy chains sent from the light-vessels as unfit for use, although perfectly good and applicable to this purpose.

There are in the store duplicates of all the buoys; they are painted regularly once in six months, and their moorings raised every year.

The buoys and light-vessels are placed in their proper positions by the surveyor himself, the positions being fixed and decided upon by angles, so that the exact spots are known upon which to place them, and from which they are never allowed to be removed, unless alterations of shoals or channels make it necessary, (when it becomes necessary to consult the Trinity corporation, London,) or by accidents occurring to them; in which latter case a few hours only are allowed to elapse before they are replaced.

Registers of the buoys are kept, showing when they were made, when repaired, and when placed, &c., with a column showing their positions by angles, remarks, &c. The present courteous and intelligent marine surveyor of the port of Liverpool (Lieutenant Lord, R. N.) is greatly in favor of iron as a material, as well for light-vessels as buoys. The northwest light-ship is 203 tons, and cost no more than one of the same size of wood would have cost, while the advantages in many respects are greatly on the side of the iron. The larger the vessel, the greater the economy of iron in comparison to wood. They draw but little

* Thus: "Red buoys on the starboard hand, and black on the larboard, when running in."

"Black and white striped buoys upon intervening banks or flats."

Superior can buoys, with perches at the "elbows or turning points of principal channels."

"Each buoy bears the initial of the channel it occupies, thus: F. Formby channel. C. Crosby channel. HF. Half-tide Swathe way. N. New channel. H. Horse channel. R. Rock channel. HE, Holbe swash. B. Beggar's Patch. L. Hoylake. V. Victoria channel."

"The buoys are likewise numbered in rotation, No. 1 denoting the outer or seaward buoy of the channel its letter indicates."
water, (the northwest only 9 feet,) and are fitted with bilge keels to keep them from rolling too heavily. The greatest possible attention is paid to all moorings. Experiments have been made upon chains of different sizes, &c. Those in use at present are fitted with wrought-iron studs, and have been found to answer infinitely better than those with cast-iron ones; the former seldom or never falling out.

This corporation, not satisfied apparently with this perfect system of lighting, &c., has further provided for the safety of seamen by adding a number of life-boats to their charge. We are aware that this does not come strictly within the limits of our instructions; but finding it intimately connected with the light-house establishment, and having heard of the many and great benefits which have resulted from it as being a part of the most complete whole, we deem it but proper to refer to it in this connection.

The boats (nine in number) are placed at different stations around the bay, well provided and well protected from the weather, ready at a moment’s notice for service. The crews are composed of experienced watermen residing near the stations of the boats, always willing and anxious to render assistance to those who may be so unfortunate as to strike upon the shoals, or meet with any other accident within the vicinity of the bay and harbor.

To insure a more certain and prompt assistance to those in distress, the corporation has an arrangement with the Steam-tug Company, by which, for the consideration of 400 guineas per annum, and 25 guineas additional for every time a steamer is required, a vessel is ready at all times, day and night, with steam up, for towing out a life-boat, and for rendering any service that may be required.

A simple inspection of the chart of the bay of Liverpool will suffice to explain the manner of masking the lights, by which the positions of the buoys are pointed out by night to the pilot, so that he can stand on his course with confidence. The system is simple and perfect, merit ing the warmest eulogies of all persons feeling an interest in the commerce of the port.

LIGHT-HOUSES OF SCOTLAND.

The “Commissioners of Northern Lights,” who are charged with the control and management of light-houses, buoys, beacons, &c., of a general character, on the coasts of Scotland, were first instituted by act of Parliament in 1786.

The board is composed of twenty-five commissioners or members, whose services are gratis, and whose professions are of a civil character, but chiefly that of the law. There is not a single nautical person attached to the board.

There is a secretary to the board; and an engineer, who is the executive officer; an auditor; and an accountant, who prepares all accounts for the committees, &c.

The local or harbor lights, fifty-one in number, are under the control and management of local authorities and trustees, supported by dues
levied upon the shipping visiting the respective ports where the lights are established.

The general board meets four times a year for the transaction of business. It receives and acts upon the proceedings of the committee meetings which have been held in the interim.

There is a standing committee, composed of sixteen members, called the "Bell Rock Committee," which meets once a fortnight during the year, except in the months of April, August, and September. This committee has charge of the lights, and appoints the finance committee, before which the auditor is required to lay all accounts twice a year, when they are examined and passed.

There is also a committee regulating "superannuated allowances," and one for "buoys, beacons," &c.

Committees are appointed for the superintendence of light-houses in the course of erection; and the board is in the habit of remitting any matters of importance which may arise to the consideration of a special committee, which examine and report upon them.

The engineer of the board attends upon all the committees. He executes all orders relating to lights, buoys, beacons, &c., and has the entire management of the executive department. He receives a salary of £700, and an allowance of £200 additional for clerk hire.

There are no agents for the inspection of lights. The engineer goes around to all the stations at least once a year, and reports the result of his observations to the board. There are two persons in the engineer's department—the "superintendent of light-keepers," who is charged with the delivery of stores at each station, accompanying the tender which delivers them, (which takes place generally twice a year,) reporting, on leaving the station, the condition in which he found the establishment; and, on his return, is required to hand over to the engineer the diary of his journey, in which is entered the observations made by him upon each station. The other person is the "foreman of light-house repairs," who, assisted by one or two men, goes, as occasions may require, to repair the lamps and light-house apparatus in general.

The engineer makes out a requisition once a year, according to a printed form, (hereto annexed,) for all stores that may be required for each light-house. These requisitions are submitted to a sub-committee, which rejects such items as may not be satisfactorily explained by the engineer, and approves all those deemed necessary for the service.

Printed forms are then issued to different parties, generally in Edinburgh; one of which each party retains, and returns the other, with the prices attached to each item required, accompanied by patterns or samples. The lowest tenders are always taken in the cases of ordinary supplies. There are no public newspaper advertisements for supplies; but applications are made to parties who are considered able to undertake the contract.

The supplies are delivered at the storehouse at Leith; compared by the engineer, the superintendent of light-keepers' duties, and the foreman of repairs, and, if found to correspond with the requirements of the tender, are received in store, from whence they are forwarded, in the tenders belonging to the establishment, to the different stations, as before
mentioned. There are at present two light-house tenders, and it is proposed to build another, to be propelled by steam.

The best winter-strained sperm oil is used in the Scotch light-houses. It is subjected to all the known modes of testing its quality; among which, one is to burn it three days; and if afterwards found deficient in quality by the report of the keepers, it is returned to the contractor.

All applications for new lights, &c., are submitted to the standing committee. Examinations are made for proper sites, &c.; and if deemed necessary, after having obtained the approbation of the Trinity corporation of England, proceed with the work. The engineer presents the plans, specifications, &c., which must be approved by the board before the commencement of the work. The light-houses are generally built by contract, under the immediate direction and superintendence of the engineer of the board, and a superintendent, who is not permitted to leave the spot, after the commencement of the work, until it is completed and received by the board. All extraordinary repairs are made in the same manner.

The buildings are constructed chiefly of the dark stone or granite peculiar to the coasts, in a plain, substantial manner. The oil cellars are fitted and finished with a proper care, as in England and France; the keepers’ houses separate from the towers, and differ very little in their general arrangements from those of England. One very simple and useful custom, of calling the keepers from their dwellings to the towers, a distance ordinarily of forty to fifty feet, was observed, which removes all necessity for the keeper to leave the light-room until regularly relieved. This consists of a small metal air tube leading from the lantern to the room of the keeper; at the ends of which are bells, which are struck by small hammers of wood, raised by blowing into the tube. The keeper, upon being called, answers in the same manner; the one making the call reversing the hammer of his bell after making the signal, so that the answer may be made.

The light-keepers’ houses are furnished with spare rooms for the engineer, and for the workmen who visit the stations for making any repairs that may be required upon the illuminating apparatus. The furniture of these rooms is supplied by the commissioners.

The domes of the lanterns are all double-roofed, of copper. No lightning rods are used.

Notwithstanding the great apparent care taken in the construction of the towers, they are generally damp inside. The use of sea sand for mortar adds to their dampness, which exists in spite of the paint which is constantly put upon the buildings. The cellars are under ground; the foundations are from fourteen to sixteen feet; and although all proper means have been resorted to, such as providing drains, &c., yet they are complained of on account of their dampness. The thermometer placed in the oil cellars does not vary more than about 3° during the year.

The dark color of the stone used ordinarily in the construction of the light-houses on the coasts of Scotland renders the towers comparatively useless during the day as guides to the navigator; but this defect is about being remedied by applying roughcast and lime to their exteriors.
The expense of a single reflector and burner for oil alone may be taken at 44 gallons per annum, or about one-third of a gill per hour.

A dioptric burner, with four concentric wicks, may be stated at about 15 or 17 of the catoptric burners.

The "Commissioners of Northern Lights" have under their control 25 public general or sea-coast light-stations, consisting of 29 lights. Of that number four are dioptric* (3 revolving and 1 fixed) lights.

The 25 catoptric lights contain............................ 424 burners.
The 4 dioptric lights, equal 17 each.......................... 68 do.

Total................................................. 492 do.

Of the catoptric lights 5 are revolving white; 4 revolving red and white; 4 fixed double lights; 3 scintillating lights; 6 fixed single lights; and 3 intermittent lights.

There are also in Scotland 38 harbor or local lights, under the control of corporations or local trustees.

The "Northern Commissioners" have three new light-houses in the course of construction. There has been an increase in the last ten years of 4 general or sea-coast lights, and of 10 harbor or local lights, in Scotland.

The reflectors are parabolic, and generally 21 inches in diameter for the fixed lights, and 24 inches in diameter for the revolving lights.

The lights are distinguished very much as they are under the Trinity Board, with some little modification. In a few cases there are two lights placed, one above the other, in the same tower—a plan not to be approved of under ordinary circumstances. The number of burners varies from 1 to 48 for each station, or from 1 to 27 for each light-house; the average for each light being about 20.

The lamps employed in the dioptric lights are the same as those employed in France. Those employed in the reflector lights are Argand fountain lamps, with burners containing wicks of about one inch in diameter. Great care is bestowed upon the manufacture of these lamps, which have their burners tipped with silver, to prevent their too rapid destruction by the great heat of the flame produced by them.

The Argand lamps are solidly made, of brass, and of different forms; although those most modern, most approved of, and most in use, are fitted with a slide apparatus, accurately formed, by which the burner may be removed from the interior of the reflector at the time of cleaning or wiping it, as also for trimming the lamp, and returned to exactly the same place, and locked by means of a key. The arrangement is an admirable one, as it insures the burner always being in the focus, and does not require that the reflector be lifted out of its place every time it is cleaned. The reflectors are securely screwed to the frame, and the focal points marked upon them for the flames of the lamps. The lamps are made in Edinburgh, and the reflectors in Birmingham, as a general rule. Lamps are also made in Birmingham. Great attention has been paid to

* All the dioptric lights introduced since 1834.
the ventilation of the Scotch light-houses. Professor Faraday's tubes are highly approved of, although they increase the consumption of oil very greatly. The best winter-strained sperm oil is used, and greatly preferred by the engineer. Experiments have been made to test the practicability of introducing a cheaper article, but they did not succeed.

At Inchkeith a mixture of vegetable oils was tried, but they were compelled to abandon its use. It is proposed to try the colza, or rape-seed. Gas is still objected to very strongly, for the usual reasons which are advanced against it.

There are several local or harbor lights in Scotland which are lighted with gas: for example, at Ayr there are three lights, (one a tide light,) all lighted with gas at an annual expense of about £48. At Greenock there are two harbor lights lighted with gas, at an annual expense of about £70. At Stonehaven two lights, one reflector and one burner to each, lighted with gas, at an annual expense of about £30; and at the harbor of Troon, &c. At the Barrahead light-house the temperature is kept at a proper state in the lantern during the winter, by pipes filled with hot water. Ordinarily, there is very little difficulty in keeping the oil in a proper state for burning in that climate.

The engineer to the board of "Northern Lights" has the entire management of the lights in the executive department. He selects his assistants to act under him in the construction of buildings, and visits the lights at least once a year. They are also visited by the superintendent of the light-keepers' duties, and by the foreman of the light-house repairs.

The light-keepers are appointed by the board. Should they fail in their duty, the engineer reports them to the board. There are two keepers at each light-house, one a principal, with a salary of £50 per annum, and an assistant, with a salary of £40 per annum. At the Bell Rock and Skerryvore there are one principal, one principal assistant, and two assistants; with salaries, for the keepers, of about £70, principal assistant £65, and the assistants each £60. In addition to their salaries, they are allowed each a suit of uniform clothing or watch cloak once in three years. They are also allowed a piece of ground large enough to produce grass for a cow, and a small garden. New keepers are instructed in their duties for three months.

In addition to the returns required of the keepers of their expenditures of oil and other supplies, they are required to keep a barometrical and thermometrical journal, with remarks upon the winds and weather. They are supplied with time-keepers, and their dwellings are kept well painted and repaired; they were in good order.

There are no light-vessels on the coast of Scotland.

The beacons and buoys are under the immediate direction of the "committee," under the direction of which they are placed, inspected, repaired, &c. The buoys are made of wood, and examined and painted twice a year.
The following is an abstract return of receipts and expenditures of the "Commissioners of Northern Lights," for 1843:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross amount of dues received</td>
<td>£44,117</td>
</tr>
<tr>
<td>Interest from bankers</td>
<td>562</td>
</tr>
<tr>
<td>From post office for Port Patrick light</td>
<td>107</td>
</tr>
<tr>
<td>Rent</td>
<td>18</td>
</tr>
<tr>
<td>For old stores, &amp;c.</td>
<td>1,792</td>
</tr>
<tr>
<td><strong>Total amount of receipts</strong></td>
<td><strong>46,626</strong></td>
</tr>
</tbody>
</table>

**Expenditures.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount for collection of dues, incidental expenses, &amp;c.</td>
<td>£2,651</td>
</tr>
<tr>
<td>Maintenance of light-houses</td>
<td>11,181</td>
</tr>
<tr>
<td>Ordinary repairs of light-houses</td>
<td>1,180</td>
</tr>
<tr>
<td>Ordinary repairs of beacons, &amp;c.</td>
<td>138</td>
</tr>
<tr>
<td>Extraordinary repairs of light-houses</td>
<td>1,600</td>
</tr>
<tr>
<td>Port Patrick light</td>
<td>164</td>
</tr>
<tr>
<td>Shipping establishment</td>
<td>2,620</td>
</tr>
<tr>
<td>Salaries of the officers of the establishment</td>
<td>2,135</td>
</tr>
<tr>
<td>Expenses of office at Leith and Edinburgh</td>
<td>379</td>
</tr>
<tr>
<td>Charitable annuities</td>
<td>77</td>
</tr>
<tr>
<td>Superannuated salaries (10 persons)</td>
<td>773</td>
</tr>
<tr>
<td>Miscellaneous expenses</td>
<td>3,353</td>
</tr>
<tr>
<td>New light-houses</td>
<td>16,529</td>
</tr>
<tr>
<td>New beacons and buoys</td>
<td>2,184</td>
</tr>
<tr>
<td>Interest on borrowed money</td>
<td>250</td>
</tr>
<tr>
<td><strong>Total expenditures</strong></td>
<td><strong>45,120</strong></td>
</tr>
</tbody>
</table>

Two tenders, in 1843, £2,418 9s. 3½d., including all expenses.
Expense of each light for the year, £542.

*Extracts from Mr. Alan Stevenson’s communication to the chairman of the Select Committee of the House of Commons on light-houses.*

1. *Mode of illumination.*—"In so far as the source of the light is concerned, I cannot say that any very great improvement has been effected since the time of the former inquiry by the Parliamentary committee, in 1834. Spermaceti oil is still employed in all the northern lights. No success has attended any attempt to render the Drummond light, which was at that time a subject of so many experiments, at all applicable to light-house purposes; nor am I aware that any one has ever indicated the direction in which inquiry might, with the greatest chance of success, be employed. All the changes that have been proposed have consisted in burning various gases under certain modifying circumstances; but I see no reason for believing that an increase of intensity sufficient to warrant the introduction of gas into light-houses has been obtained."
Its use is unquestionably attended with risk of irregular exhibition in situations so remote as most light-houses are; and in some situations it is wholly inapplicable, (as in the Bell Rock and Sherryvore,) and also in all revolving lights on the reflecting principle. In ordinary weather the present lights are seen as far as the curvature of the earth allows; and unless a light powerful enough for the penetration of a fog can be found, I see no inducement to run any risk as to the due and regular exhibition of the light, for the sake of any small increase of its intensity. Some smaller changes have been introduced in regard to the lamps, which may have been useful. The ventilation, which in the Scottish lights, however, has always been very good, has lately received some further improvements from the introduction of a careful mode, which I have adopted, for manufacturing the glass chimneys of the dioptic lights, which are now blown in a metallic mould, so as to give them a more perfect and invariable form, an element of the greatest importance in securing a proper combustion. Ventilating tubes, as will be seen from Plate XX of the account of the Bell Rock light-house, have long been used in the Scotch lights; and I have lately extended their use to the dioptic burners, for which a tube similar to that lately described by Doctor Faraday has been used. By these means the flame has been increased in volume, and also in brilliancy of effect; but the consumption of oil has been raised nearly one-fifth. Besides increase of intensity of light, I should say that, at present, a great desideratum, in regard to dioptic lights at least, is an increased horizontal diameter of flame capable of producing greater divergence of the resultant beam, and consequently longer flashes and shorter intervals of darkness, in the revolving lights. For this purpose I have tried a lamp of five wicks instead of four, as in those now in use; but the consumption of oil is very much greater—perhaps almost one-third more. The maintenance of the present lamp for dioptic lights, which has four concentric wicks, costs for oil alone about £210 per annum."

2. "In the means employed for modifying the direction of the light, so as to economize it and apply it to the best advantage, the perfection of the optical instruments has effected substantial improvements. The great lenses of Fresnel, used in revolving lights, have received a considerable extension of surface, and are now much more perfect in the adaptation of their parts, the finer polish of the surface, and in the more homogeneous and colorless material; all of which circumstances have combined to raise their power fully one-fourth. The refracting belts employed in fixed lights have not only partaken of the same kind of improvement as the lenses; but in the case of the Isle of May, which was changed to the dioptic plan in 1836, I suggested a change in the form of these refractors, whereby the distribution of the light is equalized over all the horizon, and which I am happy to say has since been adopted in France. This improvement is described in the accompanying reports, 1 and 2; and the further change in the mode of grouping the instruments in the light-room, which is described (p. 2) in No. 1, will come to be applied in the first fixed dioptic light which may be erected on the coast. Lastly, the fixed lights have received a further and most important improvement in consequence of a suggestion made by me at page 8 of No. 1. This
consists in applying totally-reflecting zones, in the room of the curved mirrors hitherto used, for the purpose of intercepting the light which passes above and below the central or principal part of the apparatus. This apparatus is minutely described in reports Nos. 3 and 4, in which tables of the results of my computations will be found. Since these computations have been made, however, the French glass has been so much improved at St. Gobin and Prémontré, that it may admit of zones of larger cross-section than I had contemplated; and as some improvements in the form, which I had considered almost unattainable, were afterwards undertaken, on the suggestion of M. Leonor Fresnel, by M. Francois, an artist of Paris, M. Fresnel computed a new series of zones with all these improvements, which I also jointly computed as a verification. The work has since been executed by M. Francois, in a manner which exceeded our best expectations. The series of zones, therefore, now consists of 19 large zones instead of 24, and 46 of the smaller size, as I originally intended; and so great has been the improvement of the glass, that little or no loss of light has, I believe, been sustained by the adoption of the larger sizes, while the manufacture has been greatly facilitated by the additional strength of the glass. This substitution of zones for mirrors, in so far as my experiments enable me to judge, seems to have increased the light derived from the subsidiary part of the apparatus by about one-third. I cannot doubt that the fixed dioptric lights of this country, in so far as the modifying apparatus is concerned, are nearly perfect. About nine-tenths* of the whole sphere of light is rendered available; and the only great improvement of which these lights seem now to be susceptible must be sought for in an increase of the intensity of the light itself. In the revolving lights, on the contrary, (besides the desirableness of greater intensity,) the defect of short flashes and long eclipses calls for some increase in the volume of the flame, or some change in the form of the instrument. This defect is felt at the Little Ross light-house, and is noticed in my reports for 1844 and 1845, whereof extracts will be found in the appendix 63. In regard to the fixed lights I may further observe, that some attempts were made to increase their brilliancy by the late Captain Basil Hall, R. N., who conceived the idea of producing a continuous light, and consequently the appearance caused by a fixed light, by means of a light in rapid revolution. On his suggestion, I made a train of experiments, under the authority of the Commissioners of Northern Lights, with the view of testing the plan; but the result, which I have described in a communication to the Royal Society of Edinburgh, and of which a copy will be found at No. 5, showed that before continuity of effect could be obtained, a rapidity of motion was required so great as to render the light incapable of effecting the retina. Another very important object in regard to the mode of illumination, and one in which, I regret to say, no late improvement has been made, is an extension of the means for distinguishing one light from another. The distinctions at present are nine in number, viz: fixed, revolving white, revolving red and white, revolving red with two whites, revolving white with two reds, flashing, intermit-

---

*In fixed lights, on the catoptric principle, only two-thirds of the light is available.
tent, double fixed lights, double revolving white lights. In France all
the distinctions are produced by variations in the time of the flashes,
but these differences seem too minute for a seaman in a stormy night,
and changes in appearance which more immediately affect the eye, are,
I think, more desirable, as affording a more direct means of arresting
attention. So far as I know, no color but red will be found to answer
the purposes of a light, as well on account of the enormous loss of light
which their production involves, as the want of a decided character which
all other colors fail to give to a distant observer at night. Chemists
may probably find new means of varying the colors of lights not liable
to such objections."

4. "The expense of a single reflector burner for oil alone may be
taken at 44 gallons per annum, or about one-third of a gill per hour.
A dioptic burner, with four concentric wicks, may be taken at about 15
or 17 of the others. There are 424 Argand burners of the common size
lighted every night in the northern lights, and four dioptic burners,
which will raise the whole number to about 484 or 492 burners.

"The greatest number of Argand burners in a single light-room is at
the Pentland Skerries high tower, where there are 27, and the average
may be taken at 20.

"A dioptic revolving apparatus, with lantern, costs about £2,250,
and a fixed light £2,260. The only item of constant difference in the
expense of the lights now and formerly, is that of the oil. At Inchkeith,
for example, which had only seven reflectors before the change, the ex-
 pense of oil, which might, on an average of years, be taken at about
£98 10s. 11d., has now become £239 4s. 1d. by the adoption of lenses.
At the Isle of May, on the contrary, the expense for oil, which was
formerly £364 19s. 10d., (there being 26 reflectors,) is now reduced to
an equality with Inchkeith, or to about £211 1s. 3d.

"The supply of oil for the northern lights in 1844 was 79 tons, of
252 gallons each. In 1845 it will be 86 tons, there being three new
lights. The price per gallon last year was 5s. 4½d. The highest price
paid during the last ten years was 8s. 5d. in 1840, and the lowest was
4s. 11d. in 1843. The supply for 1844 was 79 tons, at £67 10s., or
£5,332 10s. for that season. In the year ending 31st December, 1843,
it may be stated that in 24 light-houses the burning of the lamps (through-
out the year) was equivalent to 99,636½ hours of a single lamp; and
that the consumption of oil was 19,951½ gallons. The average number
of hours burning of the lamps at one light-house in 1843 is 4,150 hours
of every burner.

"Since the rule for exhibiting the lights between 'sunset and sunrise'
has been adopted in Scotland, an increased expenditure of oil has been
occasioned. This increase, if we estimate 492 burners at five gallons
more throughout the year, which seems a fair allowance, is 2,640 gallons,
or about £786 13s. 9d. per annum. The former rule, of making the
'going away and return of daylight' as the times of lighting and ex-
tinguishing, was departed from with a view to uniformity of practice."

"Stores are, with few exceptions, furnished by contract, without pub-
lic advertisement. These exceptions refer chiefly to optical apparatus and machinery, and certain light-room stores. The subject of extending the mode of taking contracts to other items of the expenditure occupied the attention of a committee, consisting of three members of the board, who, after much deliberation, recommended an adherence to the present practice. After the requisitions, agreeably to the printed forms, have been laid before the sub-committees on the several stations, and have been approved of, forms for tenders are issued to respectable parties for all the articles, (not excepted or disallowed by the committee.) These forms, which are 28 in number, are issued, in duplicate, to each party, (so that one may be retained by the officer,) and when returned to the secretary, a tabular view of the prices is made up by the engineer and presented to the board, who authorize him to accept the lowest offer, and to intimate the result to the parties."

"Edinburgh, April 3, 1845."

Mr. Alan Stevenson says, with reference to the French lights: "All the more important plans for the improvement and establishment of lights are submitted to this commission, (the Commission des Phares,) but the plans for new light-house towers are only discussed in reference to their fitness for the lights; and every question regarding the buildings or estimates is submitted to the general council of the administration of roads and bridges, for their final approbation. The engineer of the commission prepares all the plans, and directs the fitting up of the optical apparatus and the lanterns, and sends to the engineers of the departments the schemes for new lights, that they may make the plans for the necessary buildings connected with them. He also inspects the lights on the coast, and is responsible for their efficient condition. In the discharge of these duties he is assisted by three conducteurs of works, who generally see the apparatus fitted up, and attend to the due performance of the light-room duty."

"As soon as a new light is ready, the administration causes advertisements to be made in the most extensively circulated journals of Paris, containing a notice to mariners regarding its position, appearance, and time of exhibition. This notice is also circulated in every French port by means of placards, which are affixed by the maritime authorities, and generally appear about three months before the exhibition of the light. By a late decree, too, of the director general of roads and bridges, the engineer publishes every year a summary description of all the lights on the coast of France."

* * * * * * * * * *

FRENCH LIGHTS.

The light-house department of France is attached to the official duties of the minister, Secretary of State for the Interior, and is under the immediate control and direction of the Minister of Public Works, charged with the administration of the bridges and roads.

A central public board has the management of all light-houses, buoys, beacons, and sea-marks on the coasts, which is composed of eleven dis-

32 L H P
tinguished scientific and professional individuals, who are appointed by the government, including the engineer secretary to the commission and his assistant. This board is presided over by the Minister of Public Works, and in his absence by the Under Secretary of State for that department.

This mixed commission, called the "Commission des Phares," is composed of naval officers, (of whom there is a majority,) of inspectors of the corps of bridges and roads, and of members of the institute. It prepares the projects for all new lights, and the general council of bridges and roads judges of the propriety of all schemes for that branch of service, under the four heads of architectural design, mode of executing the works, estimate of the expense, and the preparation of the specifications of the works. The light-house commission of France is not an administrative body, but is occupied solely in questions of principle or design, and leaves to the general directory of bridges and roads the care of providing the necessary means for the construction of new works, the expenses of illumination, &c.

The central commission at Paris is charged with the duty of providing all supplies necessary for keeping the illuminating apparatus in perfect order. There is, also, in Paris, belonging to this particular branch of the public service, a central workshop and depot, under the immediate care and supervision of the secretary engineer to the commission, who superintends the construction (by mechanics employed by the administration) of all lanterns and their fixtures that may be required for the service; tests all apparatus before sending it to its destination; makes experiments upon all the optical and mechanical portions of apparatus destined for light-house purposes, combustibles, &c.; in short, this officer is charged with all the scientific details of the service, subject to the instructions from time to time which may be issued by the light-house commission. At this central depot are always kept, ready for immediate use, the various articles required in the illuminating department; such, for example, as mechanical and Argand lamps, glass chimneys, wicks, cleaning materials, &c.; also specimens of the different descriptions of apparatus used in light-houses, and apparatus constructed upon the latest and most approved plans ready for service.

All expenses incurred in the maintenance of the lights and their appendages are defrayed by the agents of the national treasury, from funds authorized by annual appropriations for those specific purposes.

No light dues are charged upon shipping in France, as in Great Britain, Holland, Denmark, Norway, and Sweden, &c.; but the whole establishment is provided for as in the United States and Russia.

The maintenance of the light-house buildings is confided to the departmental or local engineers, and the expenses are defrayed from funds appropriated for the service of the department of public works.

The establishment of new works is decided upon by the Minister of Public Works, under the advice of the light-house commission. The determination of the minister is reported officially by the secretary of the commission to the Under Secretary of State for that department, and through his office to the prefect of the department in which the proposed work is to be established. The prefect directs the chief engineer
of bridges and roads for that department to have detailed plans and estimates prepared upon the basis of the proposition of the light-house commission; these plans and estimates are transmitted through the office of the Under Secretary of State to the secretary of the light-house commission, who makes a report, to accompany them to the light-house commission. The plans and estimates are then submitted to the light-house commission, which decides whether or not the wants of the service, nautically or otherwise, are such as to require the construction of the proposed works. In the preparation of these plans and estimates the military engineer of the department is consulted, to ascertain his opinions as to the propriety of constructing these works with reference to the defences of the coast.

The details having been completed, after having undergone the strictest scrutiny in every particular, the projet is presented to the general council of bridges and roads, to be considered with reference to the architectural designs, mode of construction, estimates of expense, &c. Having been approved by the general council of bridges and roads and the Minister of the Interior, the plan is then sent to the prefect of the department in which the light is to be established, with instructions to enter into contracts for the execution of the works, under the specifications and limitations authorized by the administration.

The execution of these works is intrusted to the engineers of bridges and roads for that department. As the works advance, the contractor receives payments upon the certificates of the engineers in charge, approved by the prefect of the department, from the departmental paymaster, (as deputy of the public treasury,) and the sums are charged to the budget for works of navigation, under the head of light-houses.

The light-house towers of France are constructed in the most substantial and perfect manner possible, without there being any appearance of unnecessary or wasteful expenditure. Great care is taken in the interior arrangements of the buildings, so that they may best answer the requirements of the service. Many of the towers are constructed of a soft stone of a rather peculiar kind, which hardens by exposure to the action of the atmosphere; those constructed of that material are lined inside with brick, leaving a sufficient space between the interior of the outer wall and the brick to allow a free circulation of air, thereby securing the building from dampness. Hard burnt bricks are preferred for light-house towers, when circumstances will admit of their being employed, particularly in fitting up the oil apartments, which are placed below the surface of the earth, to insure as equable a temperature during the whole year as may be possible to attain. The keepers' apartments are finished and fitted up in a plain, substantial, and economical manner, combining all the necessary accommodation and comfort. There is a room fitted up, and properly furnished, for the accommodation of the engineer, inspector, or other person authorized to make official visits at each light-station. Especial care is taken to secure proper ventilation to the towers and lanterns—all the necessary fixtures about the light-rooms, lanterns, apparatus, &c.—the most minute, and apparently unimportant details in the exterior and interior arrangements; in short, nothing could combine greater perfection in stability, in usefulness, and a proper
economy, than is perceptible in everything connected with the lighthouses visited by us on the coasts of France.

The repairs of the light-houses and their appendages are projected and executed by the engineers of the different departments in which they exist, who are limited as much as possible, in their expenditures, by the estimates of each year for those specific purposes. In some cases the contractor general is authorized to make repairs, under the direction of the agents of the administration of bridges and roads.

Whenever application is made for a new harbor light, the subject is submitted to a local commission, assisted by the engineers of the department. The report is discussed by the light-house commission, and the same course subsequently followed as in the case of large or sea-coast lights.

All the light-house towers in France are furnished with lightning conductors, made of copper wire, twisted into the form of a rope, and about three-fourths of an inch in diameter.

In the organization of the lighting service, two systems are followed: the contract and the administrative. The ocean and Mediterranean coasts are under contract at present for nine years from 1839, for all the detail supplies of the service. (See list of charges herewith annexed.) Among the clauses and conditions, it will be perceived that the contractor general is required to be represented by a deputy in each department in which there are any lights; that the oil of colza, clarified and refined, must be used exclusively; and that the prices of oil will be regulated quarterly, based upon the average prices of the principal market in the kingdom for that particular article of commerce. Mr. Fresnel insists that this last clause has had a most salutary effect of insuring the best oil the market could produce, without the contractor running any risk of loss. On the coast of the channel, from the frontier of Belgium to St. Malo, this service is performed by the administration, except for the article of oil, which is procured under a contract entered into for three years. That portion of the coasts of France which is lighted by contract includes even the salaries of the light-keepers; but where the service is performed by the administration, the keepers are appointed by the prefect of the department, upon the recommendation of the engineers. The smaller articles necessary to the illumination are sent from the central depot in Paris, under the charge of a conducting steward. The mechanical lamps are sent to Paris to be repaired under the engineer secretary to the light-house commission. The administrative system recommends itself, for the reason that it avoids all intervention of interest foreign to that for which the lights were established. The contract system has been for a long time preferred in France, for reasons of economy, complication of accounts when performed by the administration, &c.; but the experience of the last seven years on the channel coast has sufficiently demonstrated the importance of changing it to the administrative; and it is deemed quite probable, that, after the expiration of the present leases, that system will be exclusively adopted, except for supplies of oil.

The superintendence of the lights of France is confided to the local engineers of the corps of bridges and roads. The secretary to the light-
house commission visits each year one of the three divisions into which the coast is divided, and his assistant another, so that the inspections, as far as possible, are biennial for each division. Monthly returns are made of all stores on hand, of the quantity of oil consumed each night, &c., to the secretary of the commission. (See forms and circular.) These returns are intended as checks upon the keepers, and answer the purpose admirably. A most rigid supervision is required at the hands of the inspecting engineers, and, moreover, that they employ all possible means to detect any delinquency on the part of the keepers, or other agents connected with the service. It is conceded that all these precautions may fail to produce the desired effect, but that under such a supervision few among the guilty will escape detection. The lights visited by the undersigned were clean, and presented every indication of a perfect and systematic attendance and supervision.

Indications of the range of visibility afford very meagre data for forming a correct idea as to the relative value of apparatus for illumination. It is impossible to determine with certainty the absolute range of any light, in consequence of the different conditions of the atmosphere, and of the capacities of the different observers. A first-order dioptic light has been seen fifty miles very often, and one of the fourth order as far as 16 miles Mr. Fresnel says, upon the subject of range, "We would, then, draw very erroneous conclusions as to the relative value of the useful effect of the apparatus of these lights, in taking for a basis of comparison the indications of range, which are never fixed or positive."

At the present time there are two systems of illumination in France: the old or reflector system, and the new or dioptic system. In 1822 M. A. Fresnel placed the first dioptic apparatus, ever successfully employed, in the tower of Cordouan, at the mouth of the Gironde. In 1825 the light-house commission decided upon the exclusive use of the lenticular apparatus for the illumination of the coasts of France and colonies, adopting, at the same time, the programme and report of Rear Admiral de Rossel, who had been charged, as a member of the "Commission des Phares," with that service.

Since that period new lights have been established, and old ones replaced with this new apparatus, until, on the 31st December, 1845, there were, of the 209 lights of every description belonging to the Light-house Department of France, 119 fitted with that apparatus. The remaining 90 lights were reflector lights, fitted with the Bordier Marcet (called "sideral") reflectors, and the parabolic reflectors, similar to those used in Great Britain and America. Of these last 90 lights, 77 are small harbor or temporary lights, fitted, in most cases, with a single parabolic or Bordier Marcet reflector, marking the entrance to some channel or harbor. The remaining 13 are to be fitted with lenticular apparatus of the most approved construction, in accordance with the original plan of 1825.

Engineers and other scientific and philanthropic individuals of most, if not of all the nations of the world, have made this new system of illumination an object of study and of critical examination, the results of which have been the successful, though gradual, application of it to the coasts of nearly all the commercial nations.
On the 31st December, 1845, eighty-three light-houses, belonging to foreign governments, had been fitted with lenticular apparatus, constructed in Paris, to which may be added those constructed in England and Holland, say from 15 to 20, making, including those on the coasts of France, upwards of 210, one hundred of which may be put down as of the three first orders, and the remaining one hundred and ten of the fourth order. These numbers do not include those at present in the course of construction for France, Egypt, (tower at Alexandria,) Brazil, the colonies, islands in the Pacific, &c. M. Fresnel says, with perfect truth and reason: "After these numerous and extended applications, the dioptric system of lights may be fully appreciated under the double aspect of theory and practice, and I will add, that under the first point of view the question has been for a long time out of controversy."

There are six different orders of lenticular apparatus at present employed, viz.: 1st, 2d, 3d, larger model; 3d, smaller model; 4th, larger model; and 4th, smaller model order.

The different orders are subjected to different combinations, such as dioptric, two catadioptric, one with concave mirrors, and the other with catadioptric zones, or rings of glass, in triangular profile sections, and the "diacatoptric,"* combining the dioptric portion, and the catadioptric, surmounted by plane mirrors. In addition, a spherically-curved metallic reflector or mirror is placed on the land side of all lights which are only required to illuminate from four-fifths to five-sixths of the horizon, which reflects the rays from that side back through the opposite lenses.

"There can be no doubt," says a distinguished engineer,† who has had much to do with the light-houses of Europe, "that the more fully the system of Fresnel is understood, the more certainly will it take the place of all other systems of illumination for light-houses, at least in those countries where this important branch of administration is conducted with the care and solicitude which it deserves." "To the Dutch belongs the honor of having first employed the system of Fresnel in their lights." "The Commissioners of Northern Lights followed in the train of improvements, and in 1834 sent Mr. Alan Stevenson on a mission to Paris with full powers to take such steps for acquiring a perfect knowledge of the dioptric system, and for forming an opinion of its merits, as he should find necessary." "The singular liberality with which he was received by M. Leonor Fresnel, brother to the late illustrious inventor of the system, and his successor as secretary to the light-house commission of France, afforded Mr. A. Stevenson the means of acquiring such information and making such a report, on his return, as to induce the Commissioners of Northern Lights to authorize him to remove the reflecting apparatus of the revolving light at Inchkeith, and substitute dioptric instruments in its place." * * * * "The Trinity House followed next in adopting the improved system." * * * "Other countries begin to show symptoms of interest in this important change, and America, it is believed, is likely soon to adopt active measures for the improvement of their light-houses." "Fresnel, who is

* See Mr. Alan Stevenson's report to Commissioners of Northern Lights, for this word.
† Mr. Alan Stevenson, civil engineer, &c.
already classed with the greatest of those inventive minds which extend the boundaries of human knowledge, will thus, at the same time, receive a place amongst those benefactors of the species who have consecrated their genius to the common good of mankind, and wherever maritime intercourse prevails, the solid advantages which his labors have procured will be felt and acknowledged.”

The fourth-order lenticular lights are illuminated ordinarily by means of a common fountain, or constant-level lamp and Argand burner, with a single cylindrical wick of three-fourths to seven-eighths of an inch in diameter, consuming about one and a quarter ounce of oil per hour, and forty-eight gallons per annum. The larger lights require mechanical lamps with multiple wicks, to as great a number as four, placed in concentric tubes, and the oil supplied to them by means of pumps, put in play by clock machinery. Hydraulic and pneumatic lamps have been employed in the place of the mechanical ones, but, with good reason, they are not approved of in France. For the catadioptric apparatus of half a metre in diameter, the ordinary constant-level lamps, with two concentric wicks, burning about four and a quarter ounces of oil per hour, have been employed very successfully at several points on the coasts of France, where the ordinary range of a light of the third order, for example, was not required, or for harbor lights requiring a powerful ray, or one whose brilliancy it is necessary to weaken by the application of a red chimney, with a view to give it a distinctive character. These double-wick ordinary lamps require only one keeper to attend to them. Some of the burners in France are fitted with flat wicks for small and temporary lights, although by no means common, and generally disapproved of.

The dioptric lights of France are divided into six different orders; but, with reference to their distinctive characteristics and appearances, this division does not apply, inasmuch as, in every order or class, lights of precisely the same character may be found, differing only in the distance at which they can be seen, and in the expense of their maintenance. The six different orders, as before mentioned, are not intended as distinctions, “but are characteristic of the power and range of lights, which render them suitable for different localities on the coasts, according to the distance at which they can be seen.” “This division, therefore, is analogous to that which separates the lights of Great Britain into sea-lights, secondary lights, and harbor lights; terms which are used to designate the power and position, and not the appearance, of the lights to which they are applied.”

In France there are nine principal combinations of lights possessing distinctive characteristics. These distinctions, for the most part, depend upon the periods of revolution rather than upon the characteristic appearance of the light. They are—

1. Flashes, which succeed each other every minute.
2. Flashes, which succeed each other every half minute.
3. Flashes, alternately red and white.
4. Fixed lights, varied by flashes every four minutes.
5. Fixed lights, varied by flashes every three minutes.
6. Fixed lights, varied by flashes every two minutes.
7. Fixed white lights, varied by red flashes more or less frequent.
8. Fixed lights.
9. Double fixed lights.

There are very few double fixed lights in France. They are, however, sometimes employed for the purpose of giving a very decided character to the locality. For example, the first-order lights at La Hève, near the port of Havre, and the two lights at present in the course of construction on the left bank of the Canche. Red fixed lights are not employed on the coast of France, except as a distinguishing characteristic for harbor purposes. They are doubly objectionable; first, because of the great diminution of light in consequence of the absorption of the red glass chimney; and, secondly, it loses its distinctive character in foggy weather—all lights assuming a reddish tint under those circumstances.

The revolving reflector lights are objected to because of the fact that, ordinarily, they are only distinguishable by the duration of their eclipses, which often become positive at a very short distance from the light-house, and the interval of time between any two eclipses could not be extended to a greater limit than three minutes without prolonging the duration of the eclipses to such an extent of time as to mislead the navigator by depriving him for so long a time of his point of recognition. In the revolving dioptic apparatus upon the latest and most approved plan, the duration of the eclipses is scarcely perceptible; the fixed subsidiary parts of which reflect a light constantly visible in a horizon extending nine or ten nautical miles with a second-order, and from twelve to fifteen with a first-order apparatus.

The three first of the principal combinations only are applied to the first three orders, in consideration that in the inferior orders the flashes would have too short a duration, and the eclipses would be positive at too short a distance from the light in consequence of the feebleness of the ray produced by the fixed subsidiary part of the apparatus.

The distinguished engineer secretary to the "Commission des Phares," of France, (M. Leonor Fresnel,) kindly furnished the undersigned with the results of numerous photometric experiments which were made for the purpose of testing the comparative useful and economical effects of the two systems of illumination, to which they beg leave to call particular attention. (See Note No. 1, hereto annexed.)

M. Fresnel says, in his note referred to, "the foregoing results confirm the following principles:

1. "The useful effect of a parabolic reflector increases with its dimensions, and with that of the illuminating body.

2. "The economical effect of a reflector of given dimensions is greatest when the lamp-burner is smallest.

3. "The divergence is greatest when the flame is most voluminous, or when the reflector is smallest. We cannot, then, (all other things being equal,) augment the economical effect of a reflector without diminishing its useful effect—that is to say, without reducing its brilliancy or intensity, and consequently its range. (portée.)"

"The reduction of the volume of light within certain limits is particularly objectionable when it appertains to eclipse apparatus, in which case it limits the width of the luminous cone, and consequently augments the
length of the eclipses. The same reduction applied to the foci of reflectors composing a fixed light apparatus may weaken the light in their intervals to such a degree as to produce dead angles, or become completely obscured to the observer beyond certain distances.

"It is, further, proper to remark that the horizontal divergence is not lost for useful effect, but that the divergence in the vertical sense only profits the navigator in the limited angular space comprised between the tangent at the surface of the sea and the ray termination at the distance of some miles from the light.

"Finally, there is for the calibre of the lamp-burners applicable to reflectors of given dimensions, and destined for the illumination of an equally determined range, a maximum beyond which prodigality of light ensues, and a minimum within which the illumination becomes insufficient."

The third-order smaller sized lenticular apparatus may be illuminated with very decided advantages by means of an ordinary Argand burner and single wick. Such a light would consume about two ounces of oil per hour, and is admirably adapted for harbor lights. In ordinary weather such a light may be seen from 12 to 15 miles. One keeper alone can attend to all the duties of such a light, and it is maintained in France at an annual expense of about $200."

M. Fresnel remarks, with reference to the ranges of different lights, their useful effects, &c.:

"The useful effect of a light-house apparatus is measured by the quantity of light which it projects upon the horizon. Observations of range for that purpose furnish very uncertain evidences, on account of the difficulty of ascertaining the absolute range of a light, which varies according to the state of the atmosphere, and according to the good or bad sight of the observers."

Reflector lights, with not more than six or eight burners, are attended by one keeper, occasionally assisted by members of his family. For lights with a larger number of burners, two keepers; and if the light be in an isolated position, three keepers are allowed, with, in the latter cases, certain privileges not accorded to others.

Dioptic lights of the fourth order and third order, smaller size, require but one keeper, except when in isolated positions. Two keepers are allowed to lights of the third order, larger size, and for those of the second order, in consequence of the employment of the mechanical lamp.

First-order lights are allowed three keepers; and when there are two first-order lights forming one combination, five keepers are allowed for the two lights. Lights on isolated positions, of the first order, are allowed four keepers, and for the third-order, larger size, and the second-order lights, similarly situated, three keepers are allowed."

In comparing the two systems of illumination, they should be considered under the heads—first, of absolute useful and economical effect; second, of first cost, repairs, and maintenance; and, third, of the facility and safety of the service.

* In England, Scotland, and Ireland, no difference is made between the number of keepers for dioptic and reflector lights of the same class.
The brilliancy of a catadioptric apparatus of 11.8 inches interior diameter, lighted by a lamp burning 45 grammes of oil per hour, has been found, by photometric experiments, to be equal to eight or nine Carcel burners; while that of a "sideral" reflector of Bordier Marcet, illuminated by a lamp consuming 50 grammes of oil per hour, has been found, in the same manner, equal to only four burners of Carcel; or, in other words, the brilliancy of the former is to the latter as one to two. The useful effect of the catadioptric apparatus, illuminating three-fourths of the horizon, is represented by 137700, and that of the reflector by 68400, which gives the value as one to two.

The economical effect of the catadioptric apparatus is represented by 3060, and that of the reflector by 1868; giving the value in that respect as 1 to 2.24.

No combination of reflectors can produce an equivalent to the third-order smaller size apparatus, illuminated by an ordinary fountain lamp and Argand burner, with one wick, consuming 60 grammes of oil per hour, or one burner, with two wicks, consuming 115 grammes of oil per hour. An apparatus of this sort, with a lamp of two wicks, may be seen in ordinary weather, (the horizon of the light, from its elevation above the sea level, being equal to or greater than that distance) at the distance of 15 to 18 nautical miles.

The brilliancy of a catadioptric third-order larger size apparatus, illuminated by a mechanical lamp of two wicks, consuming 190 grammes of oil per hour, (6 1/4 oz.,) has been found equal to 70 burners.

We suppose that it embraces only four-fifths of the horizon. To illuminate, by means of reflectors, the same angular space of 288°, with an effect of light about equal, 14 parabolic reflectors, of about 11 inches in diameter, illuminated by Argand lamps, consuming each 35 grammes of oil per hour, will be required. The useful effect of these reflectors will be represented by 870240, and that of the catadioptric apparatus by 1160000; and thus it is seen, that notwithstanding the very great difference in favor of the catadioptric apparatus, in the consumption of oil, it is also superior in useful effect to the light with the 14 parabolic reflectors. Further, the economical effect of the catadioptric apparatus is represented by 6105, and that of the reflector by 1776, or as 1 to 3.44: "that is to say, without estimating the expenditure of oil by unity of light, the lenticular light will be nearly three and a half times more advantageous than the reflector light." With regard to the effective expenditure of oil, they will be in the proportion of 190 grammes to 14 × 35 grammes per hour, or as 1 to 2.6.

The brilliancy of a catadioptric apparatus of the second order, with a mechanical lamp of three concentric wicks, consuming 500 grammes of oil per hour, has been found equal to 264 burners. Supposing that it is only required to illuminate three-fourths of the horizon; then, to obtain an effect about equal in angular space of 270°, at least 34 parabolic reflectors of about 20 inches in diameter will be required, which will give a useful effect which is represented by 3525120, while that of the catadioptric apparatus is represented by 4120000. The comparison between the absolute consumption of oil will be equal to 2.86 to 1; and that of the quantity of oil expended by unity of light equal to 3.33 to
1: thus, under this last report, the lenticular apparatus will be three
and a third times as advantageous as the catoptric apparatus.

The maximum brilliancy of a revolving light of the second order,
with 12 lenses, has been found to be equal to 1184 burners, and its min-
imum brilliancy equal to 104 burners. To construct a light, with para-
bolic reflectors, possessing an equal effect, it will require 24 with diam-
eters from 22 inches to 24 inches, arranged on six faces of the revolv-
ing frame. In making the comparison, however, for want of precise
data as to the lustres of those reflectors, those of about 20 inches diam-
eter will be referred to. It is supposed that the two lights compared
are constructed so as to present the same distinguishing features; the
maximum lustre of the reflector light will be equal only to 1080 burn-
ers, with other disadvantages; for the details of which, reference may
be made to M. Fresnel's note. M. Fresnel remarks in this connection:
"Without pressing further the comparison of the effects of the two
kinds of apparatus, we will perceive, without doubt, the evident advan-
tages of the dioptic or lenticular combination, which in fine weather
will not present an absolute eclipse at a less distance than from 15 to 18
nautical miles. If we now consider the expenditures of oil, we will find
first, that they are as 24 × 42 is to 500, or as 1 to 2; second, that the
economical effects will be as 2469 is to 10043, or as 1 to 4.07; thus the
lenticular apparatus will be four times as advantageous as the reflector
apparatus. "Let us remark, before proceeding further, that in employ-
ing 24 parabolic reflectors, of about 20 inches diameter, for such an
apparatus, we reach the utmost possible limit, without admitting the
employment of lanterns of a size beyond all proper bounds; and we
may also affirm, that very few of the catoptric lights, considered as
lights of the first order, equal the lenticular lights of the same charac-
ter of the second order."

With reference to the first-order dioptic lights, M. Fresnel remarks,
in his note: "Now, we have found that the total lustre or brilliancy of
an apparatus of this kind is equal in all its azimuths to 480 burners of
Carcel. But it will be practically impossible to obtain a like effect in
the catoptric system, without having recourse to the employment of 36
parabolic reflectors of about 24 inches diameter." "The difficulty be-
comes still greater, if it be necessary to attain with these reflectors the
effect of a revolving lenticular light, with eight large lenses, the lustres
or flashes of which exceed 4000 burners of the Carcel lamp."

"Let us limit ourselves, then, without entering into more full details,
to the observation, that the economical effect of a fixed light of the first
order, illuminating three-fourths of the horizon, is to the economical effect
of a light composed of parabolic reflectors of about 20 inches diameter,
as 10080 to 2469, or as 4.08 to 1: that is to say, that the first will be
(as to the expense of oil only) four times as advantageous as the second."

With regard to lights varied by flashes or short eclipse lights, "the
catoptric system is not susceptible of producing that combination with-
out great difficulty, which unites to the permanence of fixed lights the
advantage of presenting a very decided character."

No just or correct comparison can be made of the expense of con-
structing light-house towers and their appendages, inasmuch as they all
vary greatly in almost every possible respect. For example, the tower, &c., of the first-order light at Cape Bearne cost only 29,000 francs, ($5,437,) while that of the Heaux de Bréhat, erected upon a rock, surrounded by the sea, cost 532,000 francs, ($100,000 nearly,) and the old tower of Cordouan, if constructed at the present day, would cost at the least 2,000,000 francs, (about $400,000;) that is to say, as much as the tower on the Skerryvore rock, which has been recently erected on the northwest coast of Scotland by Mr. Alan Stevenson, the engineer to the commissioners of Scottish light-houses.

The amount necessary to construct and put into operation a "sideral" light for harbor purposes may be stated at 8,150 francs, or about $1,500; and the annual expense for its maintenance, including interest upon the cost at the rate of 5 per cent., at 1,207 francs, or about $225.

The amount necessary for a catadioptric smaller model harbor light may be put down at 9,181 francs, or about $1,700; and the annual expense for maintenance, including interest of first cost, &c., as above, at 1,250 francs, or about $235.

The useful effect of the "sideral" light has been found equal to 68400, and its economical effect represented by 57.

The useful effect of the catadioptric light, illuminating three-fourths of the horizon, has been found equal to 137700, and its economical effect, after the same manner, is represented by 109. The comparison of these two will, then, be in the proportion of 57 to 109, or as 1 to 1.91. "Then, besides the advantages of a double lustre, the catadioptric apparatus, in an economical point of view, is nearly twice as advantageous as the catoptric apparatus."

M. Fresnel remarks: "It is difficult to establish a comparison of a precise kind between the fixed lights of the third order in the old and the new systems, because we cannot obtain with the ordinary parabolic reflectors a passably equal distribution of light, without multiplying those reflectors to such a number as would require a much greater expenditure of oil than could be allowed for lights of that class." He says further: "I will merely observe that I have every reason to believe, from the indications contained in the table of light-houses of the United States, that among all the lights of that country illuminated by reflectors, the diameters of which do not exceed 16 English inches, there are very few whose useful effect is superior or equal to that of a catadioptric light of the third order, larger model."

The amount necessary for establishing a reflecting revolving light, with 24 parabolic reflectors of about 20 inches diameter, is estimated at 73,000 francs, or about $13,700.

Annual expense for maintenance of the same, including interest at 5 per cent. per annum, will be 8,650 francs, or about $1,625.

The amount necessary for establishing a second-order revolving lenticular light is estimated at 105,500 francs, or about $19,800.

The annual expense for maintenance of the same, including interest at 5 per cent. per annum, will be 11,075 francs, or about $2,075.

The useful effect of the reflector light is represented by 2488320, and its economical effect by 288.
The useful effect of the lenticular light is represented by 5021467, and its economical effect by 453.

The economical effect of these two lights will, then, be represented by 288 and 453, or in the proportion of 1 to 1.6. "From whence it results definitively that the lenticular light of the second order will be more than one and a half times as advantageous as the catoptric or reflector light, which we may without doubt consider as being of the 1st order, and the useful effect of which, nevertheless, could not be equal to but half of the useful effect of the former."

No comparison can be entered into between the first-order lenticular lights and reflector lights, for the reason that it is impossible to construct a reflector light which would produce a sufficiently powerful effect to be compared to a dioptric one, without increasing the dimensions of the lantern, and the number and size of the reflectors, to a degree which would be attended with very great expense, and equally great inconvenience.

From the foregoing details, which have been drawn mainly from information furnished by M. Fresnel, the following seem to be but just conclusions:

"1st. That the lights fitted with the dioptric apparatus present a variety in their power and effects, and may be made to produce an intensity of lustre, which render them of an interest, in a nautical point of view, incontestably superior to those fitted with the catoptric apparatus.

"2d. That if we take into account the first cost of construction and the expense of their maintenance, we will find, with respect to the effect produced, the new system (dioptric) is still from once and a half to twice as advantageous as the old," (reflector.)

If additional arguments and evidence were wanting to establish the now almost universally conceded fact, of the very positive and decided advantages of the dioptric system of Fresnel over all other modes of illumination for light-houses, they might be found to exist at present in an unanswerable form—that of the practical and successful application of the system, within the last few years, in nearly all the commercial nations of the world. Prior to the year 1832, there was not a single dioptric light out of France; and on the French coasts, at as late a period as 1834, there were but 14 large and 15 small, or harbor lights, fitted with the dioptric apparatus.

On the 31st December, 1845, there were belonging to the French light-house department one hundred and twelve lights fitted with the dioptric apparatus, and throughout the world not less than two hundred and ten lights fitted upon this new system; one hundred of which are of the three first orders, and the remaining one hundred and ten, small or harbor lights, without including apparatus now in course of construction at Paris, to which allusion has already been made.

The objections which have been made by a few persons to the employment of the Fresnel dioptric apparatus for the illumination of light-houses, in consequence, as they allege, of the difficulties which attend the management of the mechanical lamps with concentric wicks, (which are absolutely necessary for the proper illumination of the larger orders
of apparatus,) seem to be no longer tenable, if indeed there ever were any reasonable grounds of objection in that respect.

The twenty-three years' experience in France, (dating from the time the Cordouan light was exhibited,) where ordinary day laborers are taken for light-keepers, and the undeniable fact of the successful employment of the system for fourteen years in Holland, Scotland, and Norway; for from five to ten years in England, Sweden, Denmark, Prussia, Belgium, Spain, Sardinia, Tuscany, Naples, Brazil, West Indies, islands of the Pacific Ocean, Cape of Good Hope, &c., must be sufficient evidence to convince any disinterested and unprejudiced mind of the utter folly of such an objection at the present day.

In a communication to the government of Norway and Sweden, in 1830, M. Fresnel remarks upon this subject: "Happily, an experience of seven years has dissipated that fear, and the lenticular lights have been distinguished up to this time by the regularity of their service." Again, in reference to the same subject, M. Fresnel remarks in a note to the undersigned, that "opinions thus expressed fifteen years since, based upon an experience of seven years, have been greatly strengthened up to the present time, embracing a period of twenty-two years, since the establishment of the Cordouan light, and sustained by the results daily offered of more than one hundred and ten lights, of the three first orders, established along the coast of France and different foreign powers." "In this important point of view, then, the question seems to be irrevocably settled; and I will only add a few considerations relative to the application, more or less extended, which may be made of the new system of illumination to the vast maritime coasts of the United States."

It has been further objected that competent persons could not be procured in the United States to take charge of the lights fitted with the diopteric apparatus and mechanical lamps, for the salaries at present paid to light-keepers of the existing lights. The number of keepers necessary for those lights has also been urged as an objection to their introduction; and there is also a third objection, emanating from the same source, that the mechanical lamps could not be repaired when employed at distant or isolated points on the coast.

With regard to the keepers, no better evidence can be adduced than the opinions of M. Fresnel upon the subject, and the practical results furnished daily, wherever the lights are employed. M. Fresnel says, "that the difficulty of obtaining proper persons to fill these subaltern stations appears to be most singularly exaggerated." "In France they belong almost always to the class of ordinary mechanics or laborers, who make from one and a half to two and a half francs per day, (from 27 to 46 cts.)" "Eight or ten days will suffice, ordinarily, to instruct a light-house keeper in the most essential parts of his duty, receiving lessons from an instructor conversant with all the details of the service; and two instructing officers will be sufficient to prepare keepers for all the lenticular lights which could be successively established upon the coasts of North America." "In defence of this assertion, I will cite the example of the administration of Norway and Sweden."

As to the number of keepers allowed to the diopteric lights, there might be some reason in the objection, if it were possible to produce a
light with parabolic reflectors possessing in a reasonable degree the advantages arising from the employment of a first-order catadioptric apparatus; but as it is well established that reflectors are not susceptible (practically) of any combination which would produce a light equal in every respect to a first-order dioptic light, the objection ought in honesty to be abandoned or waived by those who prefer bad to good lights, to guide the mariner in his perilous way along our shores.

The lower orders of dioptic apparatus, illuminated by ordinary Argand lamps and burners, with single and double wicks, require but one keeper, and they produce a light far superior to those of the same class in the catoptric system, independently of the economy in the use of the dioptic lights. In Scotland and in England, where the lights are as well if not better attended than in any other parts of the world, the same number of keepers is allowed for the same class of lights, without regard to the apparatus employed, whether catoptric or dioptic. At the South Foreland, for example, there are only three keepers for a first-order dioptic and a first-order reflector light, placed about three hundred yards apart; and at St. Catherines a first-order dioptic light has but two keepers to attend it; besides, other instances might be cited, if it were deemed at all necessary. But to accomplish in the most perfect manner possible the great and important objects for which lights are established upon sea-coasts, it would seem but reasonable, and certainly desirable, rather to increase the number of keepers ordinarily allowed to catoptric lights, than to diminish the number (taking France as a basis) for those fitted with dioptic apparatus.

In regard to the repairing of the mechanical lamps, it may be asserted, without the fear of being controverted, that in consequence of the superior manner in which these lamps are at present constructed in Paris, they will perform well for a number of years by bestowing upon them only the ordinary attention necessary to keep them clean; besides, the number supplied to each light-house (from 3 to 4, and never less than 3) is a sufficient guarantee against any accidents which could prevent the proper exhibition of the lights. The same objections might, with equal propriety, be urged against revolving, flashing, or any other lights requiring clock machinery; yet such lights are found on every coast where lights exist to any extent. A simple inspection of the works of a mechanical lamp will convince any person of common understanding that any mechanic who is capable of repairing the machinery for a revolving light is equally competent to put in order any lamp used in light-houses, and particularly those known as mechanical lamps with concentric wicks.

The oil of colza is used exclusively in the French light-houses. M. Fresnel says: “From numerous experiments, it seems to me that these two oils (spermaceti and colza) may be employed with equal success in lamps of single or multiple wicks.”

M. Fresnel’s preference for the colza (to the sperm oil) is based upon two reasons: first, the colza oil is less expensive in France than sperm, owing to the fact that the vegetable from which this oil is expressed is cultivated on a very extended scale in France, Belgium, Holland, Holstein, &c.; and, secondly, the great difficulty in detecting impositions which may be and are practiced by mixing inferior oils with the sperm,
while, on the other hand, any impurities in the colza are very readily detected. No experiments have yet been made in France to test fully which of the two kinds of oil will produce the best light for light-house purposes.

There are no light-houses in France illuminated with gas. Several attempts have been made to introduce it, with every possible desire that it should succeed, but it was abandoned for the following reasons: First. "The flame of coal gas of an equal volume gives less light than the flame of the oil of colza." Second. "The gas burners, &c., are always liable to perturbations and accidents, which seem to be objectionable in the light-house service."

Oil gas has been found to produce a very brilliant flame, but the unity of light thus produced is much more expensive than by the use of lamps and burners, while the chances of accident remain as in all cases when this article is used.

The Bude, Gurney, Drummond, and other lights of the kind, have met with very little favor in France for light-house purposes. M. Fresnel made a large number of experiments upon the "Drummond lamp," (light?) as improved by M. Gaudin, but the results proved the impracticability, in his opinion, of introducing it into the light-house service. No attempts have been made to employ the light of Lieutenant Drummond as an "occasional light," to be exhibited only in very foggy weather, and, in localities in which dense fogs prevail at certain periods of the year. That such an application might be made of it, there can be but little doubt; and its comparative advantages, under such limitations, in illuminating or penetrating a fog, over any other light, may be readily imagined, when it is remembered that it has been known to cast a well-defined shadow at the distance of twelve miles.

The Bude light in the Place (square) of the Tuileries, at Paris, presents a very beautiful appearance, and should it be found expedient to introduce gas into any of the smaller light-houses, this peculiar burner will doubtless be found better adapted to the purposes of illuminating dioptic apparatus than any other combination.

M. Fresnel concludes his remarks upon the different kinds of lamps, combustibles, &c., for light-house purposes, by saying: "I am, however, far from disregarding the importance of researches having for their object the increased intensity of the luminous focus, without diminishing the volume of the flame; but these researches up to this time have not produced, to my knowledge, any apparatus which could be employed with safety for maritime illumination."

The buoys, beacons, sea-marks, &c., are under the control of the light-house establishment, yet it seldom happens that the commission at Paris is called upon to interfere in any matters connected with them. When important changes are to be made, the central authorities at Paris consult the hydrographical bureau; that bureau reports to the general council of bridges and roads, section of navigation; after which, if approved, the usual course is followed in the construction of the work, under the administration of bridges and roads. Repairs are made in the same manner that they are upon the light-houses and their appendages.

The buoyage on the coasts of France is very similar to that of Eng-
land and the northern commercial nations of Europe. The buoys placed at the mouth of the Gironde are constructed upon models obtained in England. The buoys are painted different colors, in conformity to the instructions of the local pilotage. They are moored ordinarily to blocks of granite, and iron sinkers. In a few of the harbors of France, such as Cherbourg, Havre, &c., the channel buoys are moored to screws, which are very similar to those patented by the Messrs. Mitchell. They are highly approved of for particular places. The repairs, painting, renewing, placing, &c., of buoys, are executed by contract. They are superintended by one of the agents of the administration of bridges and roads, who has under his control a vessel specially fitted for that duty. Mooring blocks are marked ordinarily by sheet-iron buoys. Beacons, stakes, &c., are generally of wood, but in many cases the former are made of masonry, and the latter of wrought or cast-iron. Sea-marks vary very much, consisting of most of the prominent objects within the range of the approaches to the different harbors.

There is but one floating-light in France; that is constructed of wood, moored and illuminated after the manner, with a few exceptions, of those belonging to the Trinity Board in England. The exceptions are, first; bronze is used in the construction of the lantern in the place of iron; and, secondly; the lamps are mechanical, the pumps of which are put in play by springs, instead of the ordinary fountain lamp. This latter, in spite of the delicate machinery of the lamp, is deemed a very decided improvement, as fulfilling much more fully the requirements of such a lamp, by preserving the centre of gravity in the same vertical during the whole time of the combustion.

The whole cost of this floating light, fitted in the most approved and perfect manner, was about 45,000 francs, or $8,400. The annual expense for maintenance, &c., is about 12,000 francs, or $2,250; of which latter sum about $1,300 is for the personnel of the vessel. Dioptric apparatus are not adapted to light-vessels, on account of their weight and fragility.

There are no screw-pile or iron light-house towers on the coast of France.

The undersigned cannot close this part of their report without most respectfully soliciting particular attention to the clear, able, and to them most satisfactory exposition of the whole French system of illumination, as detailed in the two notes (with the accompanying documents and tables) from the distinguished engineer secretary to the "Commission des Phares," to them.

The papers from M. Fresnel appear to the undersigned to contain unanswerable arguments in favor of the dioptric system of illumination, and which, perhaps, if urged by one less distinguished for scientific attainments, or by one less familiar with the subject, might lose, in the estimation of some persons, much of their intrinsic value; it was deemed most proper, therefore, to place the whole of the data and the arguments of the distinguished engineer who is at the head of the French light-house establishment in such a position, unimpaired by any remarks and opinions of their own, as to secure the attention and consideration
of those from whom alone the country can obtain the authority and the
means necessary to the accomplishment of so desirable an object as the
improvement and systematic arrangement of our light-house establish-
ment.

*    *    *    *    *

THORNTON A. JENKINS,
Lieutenant, U. S. Navy.

RICH. BACHE,
Lieutenant, U. S. Navy.

To the Hon. R. J. Walker,
Secretary of the Treasury.

———

APPENDIX.

COMMISSION DES PHARES.

In reply to the questions addressed to the Secretary to the "Commission
des Phares," by Messrs. Jenkins and Bache, officers of the Navy of
the United States of America.

QUESTIONS RELATIVE TO THE SERVICE OF LIGHT-HOUSES.

Messrs. Jenkins and Bache have done me the honor to address to me,
relating to the service of light-houses, a series of questions, to the fol-
lowing effect:

First, the administrative organization of the lights and light-houses of
France.

Secondly, the expenses incurred in their service.

Thirdly, the beacons, buoys, and sea-marks.

Fourthly, the floating lights.

Fifthly, the employment of oil or other combustibles, and the different
means of producing light applicable to light-houses.

I will endeavor to answer these questions in a satisfactory manner,
without confining myself, in their arrangement, wholly to the order in
which they have been stated.

THE ORGANIZATION OF THE LIGHT-HOUSE SERVICE.

The light-house service of France is placed under the control of the
Minister of Public Works.* The question of placing the administration
of the light-houses of France under the Minister of Marine has been
more than once agitated, but it has not found favor so far, for the reason
that that department has no engineers, except at the principal points in
our five maritime arrondissements of Cherbourg, Brest, L'Orient, Roche-
fort, and Toulon. But these agents could not, except with great diffi-

* We must except the two light-houses of Ouessant and St. Mathieu, which are under
the administration of the maritime prefect of the military port of Brest.
ulty, control the constructions and attend to the superintendence of an establishment which is for the most part so anomalous.

But, notwithstanding the department of marine does not interfere either with the construction or with the administration of the light-houses, it is represented by a majority in the mixed commission, to the judgment of which the programmes of the light-houses to be established are submitted.

Commission des Phares.

That special commission, which was instituted in 1811, has only exercised its functions uninterruptedly since 1819.

It is at this time composed of eleven members, who are—

Messrs. Dumou, Minister of Public Works, president.

Legrand, Under Secretary of State of Public Works, vice-president.

Vice-Admiral Hgalan, Director General of the depot of marine charts and plans, member of the Academy of Sciences.

Rear-Admiral de Bougainville.

Beautemps-Beaupré, Chief Hydrographical Engineer, under director of the depot of charts and plans, member of the Academy of Sciences.

Arago, astronomer and natural philosopher, member of the Academy of Sciences.

Mathieu, astronomer and natural philosopher, member of the Academy of Sciences.

Boucher, Inspector General of Naval Constructions, Director of Military Ports.


Fresnel, adjunct divisionary Inspector of Bridges and Roads,* Secretary to the Commission of Light-houses, and charged at the same time with the direction and the inspection of the service of the light-houses.

Reynaud, Chief Engineer of Bridges and Roads, adjunct to the inspector secretary.

During the wars sustained by France under the republic and the empire, our maritime illumination was so much neglected, that, when we commenced its restoration in 1819, we were compelled to treat the subject as one entirely new.

*The service (called) of "Ponts et Chaussées" comprehends, besides the bridges and roads, the interior navigation, and the maritime commercial ports. It thus forms the principal section of the Minister of Public Works. In each of the eighty-six departments of France, there is a chief engineer, assisted by numerous engineers and conductors for the ordinary service of the bridges and roads, without speaking of the engineers of the same corps attached to the large, extraordinary works, such as railroads, &c.

The government of the King is represented in each department by a Prefect, who transmits to the engineers the ministerial orders, and superintends their execution. This officer delivers, upon the certificates of the engineers, the orders for payment to the contractors or registers of the works. The military ports are placed under the direction of five maritime Prefects, who are under the orders of the Minister of Marine.
The general programme for the illumination of the coasts of France was decided upon in 1825, by the "Commission des Phares," upon the report of the late Rear-Admiral De Rossel. The lenticular system invented by Monsieur Augustin Fresnel, experimented upon, since 1823, at the Cordouan light-house, was adopted as a substitute for the catoptric or reflector system in all light-houses requiring a range (portée) of fifteen to thirty nautical miles. In the table which was then adopted for the distribution of the lights along our coasts, (and which has generally received some modifications and additions,) the harbor lights were only indicated as accessories, and the commission determined to take further advice from the local authorities upon the subject of their establishment.

Whenever the establishment of a light-house is agitated, whether included or not in the table of 1825, the commission discusses the programme, and upon its advice the Minister of Public Works resolves upon the execution of the proposed establishment. That ministerial decision is immediately made known officially to the secretary of the commission, and he submits to the Under Secretary of State an avant projet, which is addressed to the Prefect of the department, to be remitted to the chief engineer, with an invitation to have the definitive projet prepared. This projet is composed generally of the following details:

First, a general ground plan, with profiles of the levelling.
Secondly, detailed plans of the buildings to be constructed.
Thirdly, the estimates of all the works to be executed, except the lantern and the illuminating apparatus, which are constructed at Paris under the immediate direction of the secretary to the commission of light-houses.
Fourthly, the detailed estimates for these works.
Fifthly, a procès verbal of the conference, which ought to be held previously, between the engineer of the arrondissement and an officer of the military engineers, relative to the projected designs, which may be of some consequence in the defence of the coast.
Sixthly, a memoir explanatory of the projet.

These detailed parts being transmitted by the Prefect to the Under Secretary of State for the public works, are communicated by him to the inspector secretary to the "Commission des Phares," who adds his report to them, with the indication of such amendments or alterations as the projet may appear to him to demand. If the examination of these details produce some new question of nautical interest, it is previously submitted to the commission of light-houses; after which, and in all cases, the projet is presented to the general council of bridges and roads, to be considered with reference to the architectural dispositions, the system of construction, and the appraisement of the expenses.

After having been subjected to all these tests, the projet, if it be definitely approved, is sent back to the Prefect of the department to which it belongs, to become the object of a public adjudication, "au rabias."

* This permanent council, composed of inspectors, general and divisionary, of bridges and roads, is presided over by the Minister of Public Works, and in his absence by the Under Secretary of State.
In proportion to the advancement of the works, the contractor receives payments upon the certificates of the engineers and the ordonnances of the Prefect. The payments are made by the departmental paymaster, (as deputy of the treasury,) and charged to the budget (appropriation) for the works of navigation, under the head of light-houses. These sums are provided from the common funds of the public treasury, as having for their object the liquidation of claims which were created in the execution of works of national interest. Moreover, these funds are collected for duties legally established of every description; upon which it may be proper to remark, that no duties are levied upon navigation in the ports of France, specially applicable to the expenses incurred in the illumination of the coasts.

_Harbor lights._

Whenever it becomes necessary to establish a simple harbor light, the conveniences and necessities of which cannot be very well estimated, and the locating or placing of it properly determined, without the advice of the practical seamen of the locality, we commence ordinarily by submitting the programme to public inquiry, and the result of these inquiries is subsequently examined by a local commission, the report of which is submitted, with the advice of the engineers, to the central commission of light-houses. We follow, besides, in the examination of these projects, as well for the appraisement and execution of these works, the rule indicated above in regard to the large light-houses.

_Repairs and maintenance of the light-house buildings._

The ordinary repairs of the light-house buildings are projected and executed by the engineers of the departments, who are required to limit themselves as much as possible to the funds appropriated in the budget of each year for that special object; these works are, besides, according to their greater or lesser importance, confided to the contractor general, or executed by the government under the superintendence of the agents of the administration of bridges and roads.

_Illuminating service of the light-houses._

Among the questions before referred to, one of the most important, without doubt, is that which relates to the organization of the lighting service of the establishment of France.

Two systems are followed in this respect: the contract, and the administrative.

The lighting of our ocean and Mediterranean coasts has been put under contract for nine years; the contractors providing for all the details of the service.

The printed sheet of charges which I enclose to Messrs. Jenkins and Bache will suffice to explain the details of that contract, without any enumeration of its clauses here. I will call attention only to the following:

First, that the contractor general is represented by a deputy in each department.
Secondly, that the oil of colza, clarified and purified, must be used exclusively in the illumination of the light-houses of France.

Thirdly, in regard to the very great variations which take place in that article of commerce, the administration has abandoned the price fixed for the whole time of the contract. The price of the oil used during each quarter is regulated according to the mean of prices at Lille, (the principal market for the oil of colza,) excepting the necessary additional expenses for transport, &c., and the reduction of the discount of the adjudication. This last clause has had an excellent moral effect in removing the chances of loss in such a contract; and since it has been in force, it is very rarely that the quality of the oil is complained of, whatever may have been the price.

Along the coast of the channel, from St. Malo to the Belgian frontier, the illuminating service of the light-houses is performed by the administration, except the supplies of oil, for which a triennial contract has been entered into.

In this last system, the keepers of the lights of each department are commissioned by the Prefect, upon the nomination of the engineers. The wicks, chimneys, and other small articles necessary to the illumination, are sent from the central light-house workshop or depot, under the charge of a conducting steward.

The mechanical and other lamps which require repairs are sent to Paris, to the same agent, who provides for their repair and sends them back, under the direction of the inspector secretary of the commission of light-houses.

The administrative system, independently of its very great economy to the government in removing the abuses inseparable from the agreements of forfeiture, offers a capital advantage; it is, that it avoids in the service all intervention of an interest, foreign to that for which the light-houses were established.

We conceive that the contract system has an inevitable tendency to reduce as much as possible the expenses to which it is subjected, and particularly those which arise from the consumption of oil. The keepers, selected and paid by the contractor, (adjudicataire) and yet under the control of the administration of bridges and roads, find themselves subjected to two influences which may become antagonistical, and this equivocal position tends to the demoralization of these agents, who are too often deficient in the discernment and strength of mind necessary to guard them against a deviation from the line of duty in so delicate a situation.

Considerations of the inherent complication of the accounts of an administration, as well as the inconveniences arising from the increased labors of the engineers employed in the maritime departments, have caused for a long time, in France, the preference to be given to the system of contract under penalties, for the lighting of the light-houses. But the experience of the last seven years upon our channel coast has sufficiently demonstrated the superiority of the first or administrative system, and it is more than probable, that, after the expiration of the present lease upon our ocean and Mediterranean coasts, the administra-
tive mode will be exclusively adopted, with the exception of a contractor for the supplies of oil.

*Superintendence and inspection of the illuminating service.*

The superintendence of the light-house service of France is confided to the engineers and managers of the bridges and roads; who, independently of their frequent visits to the light-houses, collect and arrange the observations upon the subject of lighting the coasts, of the maritime authorities, navigators, and of the agents of the customs.

The secretary to the light-house commission visits, each year, one of the three light-house divisions into which the coasts are divided, and his assistant so aids in these inspections that they are made, as far as possible, biennial for each division.

With the view to keep the administration advised of the condition and of the wants of the light-house service, the principal keeper of each establishment furnishes, at the end of each month—first, a table showing the condition of the supplies of oil, wicks, chimneys, linen, polishing rouge, &c.; secondly, a table indicating for each night the quantity of oil consumed by the lamps with multiple wicks. These monthly tables are transmitted to the inspector secretary of the light-houses. The examination of these tables, particularly that portion of them relating to the consumption of oil, offers a subsidiary means of controlling the keepers in the performance of their duties, by showing the engineers whether or not the quantity of oil burnt corresponds to the normal effect of the light. I feel it my duty to insist upon this capital point.

Experience very soon teaches the keepers that a lamp requires less attention, and is more easily managed, when the wick is kept at a low point, producing a comparatively weak light, than when it is elevated to its proper height, and develops a sufficient volume of flame to produce its normal effect. These agents are then too often inclined, from sheer laziness, to keep the flames low, and that independently of the consideration of illicit benefits which they derive from the contractor; for the same provoking disposition is met with among the keepers of light-houses which are supplied by the administration, (régie.) That culpable dereliction of duty could not entirely escape the investigations of an active superintendence; but nocturnal visits could not be sufficiently frequent, particularly to light-houses in isolated positions at sea, to be completely efficacious, and the results of observations made at a distance are too often modified by the perturbations of the atmosphere to insure a just appreciation of the state of the illumination.

It is, then, essential to seek, in the examinations of the consumption of oil, a subsidiary means of control; and the false declarations which may be feared in that respect, on the part of the principal keepers, cannot fail to be detected sooner or later, by the comparison of the figures of the total and partial consumptions of each month. I forward here-with the forms of the monthly tables referred to, and also the ministerial circular relating to the same subject.
Range (portée) of the lenticular lights.

Before I speak of the means of maintaining the illumination of the light-houses in its normal state, I will reply to the question addressed to me by Messrs. Jenkins and Bache upon the subject of the range (portée) of the lenticular lights.

The indications of range can afford but very uncertain ideas as to the relative merits of the illuminating apparatus, as I stated to Mr. Pleasonton in my letter bearing date the 25th August, 1843. In fact, we cannot determine with precision the absolute range of light-houses, in consequence of the great uncertainty resulting from observations of this kind, as well from the frequent variations in the transparency of the atmosphere, as from the capacity of vision of different observers. I will add, that it is rare to find in the horizon of a lenticular light-house of a superior order a point of observation answering to the limit of visibility of its light, in good weather.

From the platform at "Mont Bearn," I have seen, at different visits, the flashes of the light situated on "Mont St. Loup," near to "Agde," a distance of 92 kilometres, or about fifty nautical miles. The light of "Agde" is a first-order revolving lenticular, with eight large lenses. Notwithstanding that the range of this same light is only estimated to be 27 nautical miles in the descriptive table for the use of navigators, because of its elevation of 126 metres (413 feet 5.88 inches) above the level of the sea—its horizon extends to 30 nautical miles for an observer placed at about 30 feet, or ten metres, above the same level. But the indications of that table have been generally kept within the effective range of the lights in good weather, in consideration that the atmospheric perturbations reduce them very often, and that in the great majority of cases it is much less inconvenient for the navigator to deceive himself in the belief that he is nearer to, than farther from the coast, than he really is.

I will take, for a second example, the first-order fixed lenticular light at the "Isle of Ouessant." Its range is given 18 nautical miles in the official table. Nevertheless, in consequence of its elevation, its effective horizon extends to about 26 nautical miles for an observer placed at about ten metres above the level of the sea; and I have seen its light more than once from the platform of the light of "Bec-du-Raz," at the distance of 31 nautical miles.

I will cite, for the third example, the small catadioptric light of the 4th order, of the "Seven isles," (northern coast.) Its range is only marked 10 nautical miles, although it is seen without difficulty from the light of the "Heaux de Bréhat," a distance of 16 miles.

We would, then, draw very erroneous conclusions as to the relative value of the useful effect of the apparatus of these lights, in taking for a basis of comparison the indications of range which are never fixed or positive.

To establish, rationally, comparisons of this sort, it is necessary to have recourse to the photometric operations, such as I have detailed in my note bearing date 31st December, 1845. I deem it unnecessary to point out the reduced ranges prepared for the use of navigators, which
may be consulted by a reference to the description of the French lights, comprising a series of the lenticular apparatus in most common use, with the exception of the second order of fixed light.

QUESTIONS RELATIVE TO THE DIFFERENT MEANS OF PROCURING LIGHT, APPLICABLE TO THE ILLUMINATION OF LIGHT-HOUSES.

I have kept these questions to be answered last; so that what I had to say relative to the organization and the expenses of the light-house establishment might remain in connection.

It has been a long time since wood and coal were used as proper combustibles for the illumination of light-houses, incurring, as they did, very considerable expense in proportion to the effect produced, giving a light of very unequal brilliancy, and one which could only be kept up with great difficulty.

It is well understood, at the present day, that in the illumination of the coasts the best part of the rays of light emanating from a focus will be lost, if not collected and brought to the horizon by means of a catoptric or dioptric apparatus, which supposes the use of oil lamps and burners, or gas burners.

Employment of oil.

Two kinds of oil are principally used in the illumination of light-houses, spermaceti oil and the oil of colza.* From various experiments, it seems to me that these two kinds of oils may be employed with equal success in lamps of single or multiple wicks.

In England and the United States spermaceti oil is, if not exclusively, at least generally employed for the illumination of light-houses, while in France the colza oil only is admitted for that purpose.

There are two reasons why we prefer the oil of colza:

1st. It is more economical.

2d. The difficulty of detecting and proving impurities, which too often exist in spermaceti oil. An examination should be made to ascertain which of these two oils give, for an equal volume of flame, the greatest quantity of light; but I have not yet made, in that respect, sufficiently precise experiments to give their results with perfect confidence.

Employment of gas.

The employment of gas has been often proposed, and it has been tried in several places for illuminating light-houses. So far as the development of the flames, and the facility with which they are kept at a normal height are concerned, that combination would seem to offer decided advantages. However, they have been discarded, for the two following reasons:

1st. The flame of coal gas of an equal volume gives less light than the flame of the oil of colza.

* Oil of colza; the oil expressed from the seed of the *brassica oleracea*, a species of cabbage.
2d. The gas burners, &c., are always liable to perturbations and accidents, which seem to be objectionable in light-house service. In fact, gas produced by the distillation of oil in a retort gives a very brilliant flame; but the unity of light thus obtained is much more expensive than that produced by the use of lamps, and the chances of accident remain the same as in the use of all other kinds of gas. Such a grave consideration as the security of the service explains the little favor accorded at present to combinations which have for their object increased brilliancy of the flames of the ordinary lamps, by the application of a current of oxygen gas to them, (such as has been suggested by Mr. Gurney?) or the production of light by two united currents of hydrogen and oxygen gas, upon the plan of Mr. Drummond.

I have made a large number of experiments upon the lamp (light?) of Mr. Drummond, as improved by Mr. Gaudin; but, as brilliant as the results were, I cannot believe that such an apparatus is adapted, practically, to the illumination of light-houses. It may be remarked, besides, that the oxyhydrogen lamp has only been made (up to the present time) to produce a luminous focus of very small volume, and therefore does not fulfil the condition of sufficient divergence for the large illuminating apparatus.

With reference to the large gas burner (known as a Bude light) which illuminates at this time the Place of the Tuileries, I will merely add, that several of that description of burner were made more than twenty years since, from designs by my brother, Augustin Fresnel, and that the application of it to the illumination of light-houses was abandoned, for the reasons above specified.

I will cite, lastly, a kind of lamp which is well known in the United States, (where I believe it was invented,) which is fed with alcohol, holding in solution 30 per cent. of the essence of turpentine. But, in consequence of the danger arising from the use of alcohol as a combustible, I have not dared to propose the introduction of it even in the small harbor light-houses.

I am, however, far from disregarding the importance of researches having for their object the increased intensity of the luminous focus, without diminishing the volume of the flame; but these researches, up to this time, have not produced, to my knowledge, any apparatus which could be employed with safety for maritime illuminations.

LEONOR FRESNEL.

PARIS, January 11, 1846.

P. S.—I perceive that I have omitted replying to the question of Messrs. Jenkins and Bache relative to the employment of the screw piles of the Messrs. Mitchell for light-houses.

I have been told that this mode of construction has been successfully employed in England; but I have not collected upon that subject details sufficiently full to justify an expression of opinion.

I need not add that this mode of construction, which has been proposed to supply the place of certain floating lights, may lead to serious consequences if attempted to be erected upon a shifting bank.

L. F.
MEMOIR PRESENTED TO THE ACADEMY OF SCIENCES, JANUARY, 8, 1844.

[Létourneau & Co., successors of Messrs. Soliel, sr., and François, jr., constructors of dioptric lights upon the system of Mr. A. Fresnel, "Rue des Poissonnières, No. 24, près et hors la barrière Poissonnières à Paris."]

Note upon the catadioptic apparatus constructed by Mr. François, jr., for the Scotch light at Skerryvore.—(Commissaires, MM. Arago, Mathieu, Babénet.)

"The lenticular apparatus imagined by M. Augustin Fresnel comprises, independently of the fixed or movable dioptric drum, an accessory part, destined to collect and direct towards the horizon the luminous rays which, issuing from the focal centre, pass above and below the lenses.

"This accessory part has been in most cases formed by a system of fixed concave mirrors, arranged in horizontal zones, both above and below the lenticular drums.

"In the two light-houses of Cordouan and Marseilles the revolving dioptric drum is surmounted by a system equally movable, composed of eight lenticular panels arranged in the form of a truncated pyramid, and as many plane mirrors to convey towards the horizon the eight luminous beams of light emerging perpendicularly to the faces of the pyramid. A third combination, preferable to the two others in the double aspect of theory and practice, has been applied by the inventor to the small lenticular lights of twenty-five to thirty centimetres of interior diameter. In these apparatus, which, in consequence of their small size, are not adapted to the employment of mirrors, the accessory catoptric system has been replaced by a catadioptic system of rings or zones, in triangular section, producing total reflection.

"The first apparatus of this description was constructed a short time before the death of M. Augustin Fresnel, by M. Tabouret, conductor of bridges and roads, attached to the special service of the light-houses.

"The application of this system to the apparatus of the largest size, ought, at that time, to have appeared almost impossible. Scarcely, in fact, could the shape of the dioptric rings of 75 to 80 centimetres in diameter for the large plano-convex lenses be obtained. As to the fixed dioptric drums, of diameters exceeding 30 centimetres, they were composed of cylindrical elements, the assemblage of which presented, in place of an annular, a polygonal system of 16 sides for the apparatus of 50 centimetres diameter, (third-order smaller model; ) 20 sides for the apparatus of one metre in diameter, (third-order larger model; ) 24 sides for the apparatus of one metre 40 centimetres in diameter, (second order; ) and 32 sides for the apparatus of one metre 84 centimetres in diameter, (first order.)

"A catadioptic polygonal system could, without doubt, be executed by the means employed for the polygonal dioptric system; but the adjustment of such a multitude of prisms of reflection, the positions of which could not be exactly regulated except when put up, presented an inadmissible complication.
"It was necessary, for the practical solution of the problem, that the moulding and cutting of the large pieces of glass should be performed by an improved method. A manufacturer of mirrors, at Newcastle-upon-Tyne, England, (Mr. Cookson,) placed with regard to the making experiments upon the subject, in a singularly favorable position, because of the facilities of every description which his vast establishment afforded him, made the first attempt in 1836, to construct the dioptric drums of the first order entire, which up to that time had been formed in prisms of 32 panels. The results of these first essays, without being fully satisfactory, stimulated the zeal of the French artists, who were devoting themselves to the fabrication of the lenticular apparatus; and very soon after, we obtained dioptric drums of nearly two metres in diameter, executed entire, with a precision which increased the useful effect of that principal part of the apparatus about one-fourth.

"From that time the project of constructing upon a large scale the catadioptric apparatus was permitted to recommence, with some chances of success. However, the considerations of expense and little prospect of profits, &c., were very discouraging.

"Nevertheless, the able Scotch engineer charged with the construction of the Skerryvore light-house (Mr. Alan Stevenson) devoted himself with zeal and assiduity to the idea of crowning that monument (which cost about two millions of francs) with the most perfect illuminating apparatus which it was possible to construct, in the present state of the arts and sciences.

"The programme was adopted by the commission of Scotch light-houses, and it was determined that the Skerryvore rock should be marked by a catadioptric apparatus of the first order, the optical parts of which should be constructed at Paris.

"A correspondence followed upon the subject between Mr. Alan Stevenson and Mr. Leonor Fresnel, the engineer secretary of the commission of French lights. The latter first calculated the elements of, and caused to be constructed, as a first attempt, two catadioptric apparatus of one metre diameter, (third order,) one of which, constructed at the establishment of Mr. Henry Lepaute, has illuminated for some months past the entrance to the port of Gravelines; and the other, constructed by M. François, jr., is destined for the light-house which is being erected at the mouth of Abervrach, upon the northwest coast of Finisterre.

"In spite of the complete success of the first experiment, the fabrication of the reflecting rings of the first order always presented itself as a grave and perilous enterprise.

"Even the secretary to the commission of French lights, in remitting to M. François, jr., the table of the centres and radii of curvature of the 19 glass rings or zones which were required to form the catadioptric part of a first-order light, deemed it his duty to insist that that artist should weigh well the engagement which he was about entering into with the administration of the Scotch lights. M. François, jr., did not hesitate a moment. He undertook resolutely a work of great public utility which required in its accomplishment the overcoming of grave difficulties.

"One may form some idea of these difficulties by a simple inspec-
tion of the table of radii of curvatures of the reflecting surfaces of the catadioptric rings, which vary from 6,816 metres to 8,749 metres.

"The ring No. 1, which answers to the maximum radius, has two metres of exterior diameter. The two adjacent sides of the obtuse angle (of 117° 26' 42") have respectively 92.380 millimetres and 95.209 millimetres of length. The two refracting faces have been supposed rectilinear in the calculation; but in consequence of the difficulty of executing with precision conic surfaces, we have (following the ingenious idea of the inventor) substituted for the two generating right lines two arcs of circle of equal radius, (four metres,) taking care to turn them in an inverse sense, so that the convergence resulting from the convexity of one face was compensated by the divergence resulting from the concavity of the other face.

"Each ring has been composed of four equal arcs.

"These pieces were first run into a rough shape at the manufacture of Saint Gobain, in the moulds furnished by M. François, jr.

"The first operation presented difficulties which would have discouraged one less determined, and one possessing a mind less fertile in resources.

"Each rough ring was afterwards rubbed with grit or freestone, smoothed with emery, and polished with English red, upon a circle moved by steam machinery.

"It may be conceived how many precautions are required in the perfect execution of an annular reflecting surface, which is cut or shaped by means of a rubber, grinding it with an oscillating arm or lever of 8 metres 75 centimetres in length, and how much care ought to be taken to study the means by which to insure the rigidity of this arm or lever, as well as the exactitude of the position and the fixedness of the centre of rotation.

"Not only has this difficult problem been solved with perfect success, but it has been done without groping or wavering, without false movements, and without having to regret the loss of one ring broken upon the grinding circular frame.

"After having been verified by the reflection of a red ball placed in their focus, the rings or zones were put together in panels.

"To fulfil the requirements of Mr. Alan Stevenson, M. François, jr., divided his catadioptric dome or cupola, into eight spindles, embracing each, 45 degrees. One of these spindles has been put under experiment twice at the observatory. Illuminated by a lamp of the first order, with four concentric wicks, burning from 670 to 700 grammes of oil per hour, this catadioptric panel presented a brilliant bar of light, which, after the mean of six observations of equal shadows, was equivalent to 140 burners of the Carcel lamp, burning 42 grammes of oil per hour.

"The catoptric cupola, which the new system replaces, is composed ordinarily of seven horizontal zones, containing each 82 concave mirrors. Its brilliancy appeared greater, or lesser, according as it was placed in the direction of the axis, or of the intervals of the mirrors, but the mean lustre corresponding to the useful effect has been found to be 87 burners of Carcel."
“Thus, then, the useful effect of the new crown is to that of the old one as 1 61 to 1.

“It is to be presumed that the same results would be found to exist, or pretty nearly the same, for the part below the lenticular drum; and, as we have found 46 burners for the mean brilliancy of the four lower zones of mirrors, we may count upon 74 burners for the brilliancy of the six corresponding catadioptric rings. The value of a fixed lenticular drum of the first order, with annular elements, being, besides, equal to 360 burners, we may recapitulate by the following little table, the approximation to which it refers:

<table>
<thead>
<tr>
<th>Lustres or brilliancy, measured in burners of Carcel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>First system.</td>
</tr>
<tr>
<td>1st. Fixed dioptic drum...............</td>
</tr>
<tr>
<td>2d. Accessory parts</td>
</tr>
<tr>
<td>Cupola .............</td>
</tr>
<tr>
<td>Lower zones ......</td>
</tr>
<tr>
<td>Total.........................</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

“Finally, the substitution of the prismatic rings in place of the mirrors of a first-order fixed light will augment the mean brilliancy 81 burners; that is to say, more than equal to the value of a light of the third class.

“Tol that increase of the effect of 16½ per cent. upon the total brilliancy, two capital advantages are joined; one, the equal distribution of light, and the other the stability of the reflecting power of the catadioptric rings.

“Although the fiscal question is only one of a secondary consideration here, yet, perhaps, it may not be superfluous to say a word upon it in concluding.

“The system of eleven zones of curved mirrors of a light of the first order costs, including the subsidiary pieces. 6,000 francs. The corresponding catadioptric system has been tendered for the price of......................... 20,000 “

| Augmentation......................... | 14,000 “ |

“If, then, we take for example a light of the first order, costing annually for illuminating, and the ordinary service ......................... 7,500 francs.

Add the interest on first cost of illuminating apparatus.. 1,500 “

9,000 “

“we will find that the above calculated advantage of 16½ per cent. would be equal to 1,485 francs, a larger sum than the interest upon the 14,000 francs, the excess of the price of acquisition.

“Thus, then, considering the new system in a fiscal point of view only, we perceive that the augmentation of useful effect which it will produce will not be acquired at too high a price.”
Mitchell's patent screw mooring.

SIR: Permit us to present to your notice a brief description of our patent mooring, an instrument now well known in many of the principal ports and harbors of the United Kingdom; where they have been for a considerable time in constant use, and where, we may add, they have had the unqualified approbation of every scientific and nautical person who has had occasion to consider the subject.

The mooring is constructed (as its name implies) on the principle of the screw, but differing essentially in form from that well-known instrument; for while the spiral thread makes little more than one turn round its shaft, it is, at the same time, extended to a very broad flange, the hold which it takes of the ground being proportional with its breadth of disk.

Where it is necessary to provide against a very heavy strain, we have hitherto used moorings of three feet six inches diameter, and the principle is capable of still further extension.

A mooring of the above diameter presents a resisting surface, equal to about ten square feet, whereas the palm of the largest anchor in the British navy does not exceed half that size; and some estimate of its holding power may be formed when it is shown that this broad surface can be screwed to a depth many times greater than that to which the palm of an anchor can ever descend.

The method of laying down this mooring is briefly thus:

A strong mooring chain being so attached to it as to allow the screw to turn freely without carrying the chain round with it, a powerful iron shaft is then fixed firmly on the upper part of the mooring, which is formed square for that purpose, fitting in the same manner as the key to a watch in winding up; it is then lowered by the mooring chain, joint after joint being added to the shaft till the mooring has reached the ground. Eight levers of twelve feet in length are then applied to the shaft, in manner of a capstan, when the operation of screwing the mooring into the ground commences.

Two boats or barges having been moored firmly, head and stern, close alongside each other, and the upright shaft rising between them about midships, the men place themselves at the bars or levers, and move round from one boat to the other, the two giving them a safe and convenient platform. By a simple contrivance, the levers are occasionally shifted upwards, as the screw and shaft sink into the ground.

When the number of men employed can no longer force the screw around, the levers are removed and the shaft drawn out of the ground, leaving the mooring firmly imbedded, with the chain attached to it; a buoy being shackled to the other end of the chain, the work is completed the time required for the whole operation seldom exceeding a few hours.

These moorings have been placed in every description of ground—rock alone excepted; and the qualities which entitle them to the patronage of the public are, perfect security to shipping, great economy, an entire freedom from the many objections to which other moorings are liable. On these subjects, however, we shall not enlarge, but refer the letters and testimonials hereto annexed, which have been selected from a great number of documents received on the subject.
Any communications addressed to Alexander Mitchell & Son, engineers, 2 Alfred street, Belfast, shall receive prompt attention.

We have the honor to be, sir, your very obedient servants,
ALEXANDER MITCHELL & SON.

HAVEN MASTER’S OFFICE,
Bristol, February 19, 1837.

DEAR SIR: Understanding that you are now in Bristol for the purpose of laying down two more of your patent moorings in the floating harbor, I consider it but as an act of justice to yourself and your invention to give you this testimony of the great utility and stability of those you have already placed at our basin entrance, and in King road—the former of which was fixed in October, 1834, and the latter in July, 1835; since which periods they have been both subjected to some severe trials, and have never started from the position in which they were placed. The one in King road has had at one time two ships of nearly 400 tons register, and one of our largest class steam-vessels, riding by it in a strong tide and fresh breeze; and when it is considered that the Bristol channel is open to the heave of the sea of the Western ocean in northwesterly winds, and that ships of 300 tons are known to pitch bowsprit under in King road, where there is also a run of tide not much exceeded in any part of the world, it has proved itself to be fully equal to anything that can be required from a mooring. Another great advantage it has over any other mooring deserving of notice is, the next to impossibility of vessels hooking it with their anchors, and thereby risking the losing them.

Wishing you the success your invention deserves, which needs only to be known to supersede the use of all others,

I am, dear sir, your obedient servant,
EDWARD ROBE,
HAVEN MASTER, PORT OF BRISTOL.

TO ALEXANDER MITCHELL, ESQ., OF BELFAST.

GLASGOW, MAY 7, 1837.

DEAR SIR: The charge I had in putting down the patent moorings, under your direction and superintendence, at the Broomelaw, in the spring of 1835, enables me, I think most confidently, to certify their superiority to any mooring that I know of for permanent moorings in harbors and roadsteads. The great strain they bear, as shown in experiment with the powerful steam-tug Hercules, the safety for vessels grounding above them, the unexpected ease with which they are put down, and their exemption from frequent lifting, to which other moorings are liable, will make me recommend them on all opportunities for stationary moorings.

Wishing the like success in introducing your moorings into other ports, remain, dear sir, respectfully, your obedient and faithful servant,

WILLIAM JOHNSTONE,
HARBOR MASTER.

TO ALEX. MITCHELL, ESQ., OF BELFAST.
GREENOCK, August 25, 1836.

Dear Sir: We have the pleasure to inform you that the patent moorings laid down by you, in the spring of 1835, in our east and west harbors, and also the two since laid down in the roadstead, have, in every respect, fully answered our expectations, none of them having shifted in the least during the heavy gales which have since occurred. The moorings formerly laid down in the roadstead consisted each of a heavy chain stretched along the ground, having a large anchor attached to either end and a bridle chain and buoy rising from the centre. Besides the inconvenience of these moorings, after being dragged from home by heavy strains, ships, while lying in the roadstead, frequently had their anchors entangled with the chains; in freeing themselves from which, much time was consumed, and the mooring anchors often brought home, and thus rendered unserviceable till they could be again laid down—a work only to be accomplished in fine weather, and at a very heavy expense. Your moorings, on the contrary, by being forced far into the ground, hold equally well in every direction; thus rendering ground chains unnecessary, and avoiding the possibility of anchors getting foul of them. Indeed, the advantages they possess over common moorings in all situations, but more especially in harbors where vessels are liable to take the ground, were evident to us from the first. The only doubt on our mind was as to the difficulty to be apprehended in sinking them to a sufficient depth in hard ground; and if placed in light, soft ground, as to their holding fast. On these points we are now assured, the moorings alluded to above affording satisfactory proof on both these points. In fine, your moorings, in our opinion, combine with the greatest stability, the important advantages of safety, convenience, and economy.

We are, dear sir, your very obedient servants,

A. SHANNON, Harbor Master.

JOHN COOPER, Harbor Master.

ALEX. MITCHELL, Esq.

Testimonials from Belfast.

BELFAST, August 11, 1837.

In the month of September, 1833, Mr. Mitchell put down three of his patent moorings in the river, opposite the coal quay of Belfast; since which time they have been in constant use, having frequently ten or more vessels attached to each, and that during the most stormy weather of the last four winters. The diameter of the screw of these moorings is two feet, and the ground in which they are placed is stones, sand, and gravel.

HENRY CURRIN, Harbor Master.

BELFAST, August 11, 1837.

On the 29th of July we had a heavy gale of wind from the northwest; some days prior to which, a large timber ship, the Margaret, had been placed at one of Mr. Mitchell's patent screw moorings, laid down in the roadstead of Garmoyle. During the prevalence of the gale, the bridle

34 L H P
chain, made from iron two inches diameter, parted, leaving Mr. Mitchell's moorings undisturbed. During a gale last winter, a one-fluked mooring anchor, of 20 cwt., buried deep in the ground, was dragged from its place by a large vessel attached to this same chain. This, we consider, affords satisfactory evidence of the superior stability of Mr. Mitchell's patent mooring.

Signed by order of the corporation for preserving and improving the port and harbor of Belfast.

JAMES LEWIS, Ballast Master.
GEORGE McKIBBIN,
Dock and Pilot Master.

__

Mitchell's screw-piles and moorings.

Sirs: Permit us to present to your notice a brief description of our patent mooring, an instrument now well known in many of the principal ports and harbors of the United Kingdom, where they have been for a considerable time in constant use, and where, we may add, they have had the unqualified approbation of every scientific and nautical person who has had occasion to consider the subject.

The mooring is constructed (as its name implies) on the principle of the screw, but differing essentially in form from that well-known instrument; for while the spiral thread makes little more than one turn round its shaft, it is, at the same time, extended to a very broad flange, the hold which it takes of the ground being proportional with its breadth of disk.

Where it is necessary to provide against a very heavy strain, we have hitherto used moorings of three feet six inches diameter, and the principle is capable of still further extension.

A mooring of the above diameter presents a resisting surface, equal to about ten square feet, whereas the palm of the largest anchor in the British navy does not exceed half that size; and some estimate of its holding power may be formed, when it is shown that this broad surface can be screwed to a depth many times greater than that to which the palm of an anchor can ever descend.

Patent screw mooring.
The method of laying down this mooring is briefly thus:

A strong mooring chain being so attached to it as to allow the screw to turn freely without carrying the chain round with it, a powerful iron shaft is then fixed firmly on the upper part of the mooring, which is formed square for that purpose, fitting in the same manner as the key to a watch in winding up; it is then lowered by the mooring chain, joint after joint being added to the shaft till the mooring has reached the ground. Eight levers of twelve feet in length are then applied to the shaft, in the manner of a capstan, when the operation of screwing the mooring into the ground commences.

Two boats or barges having been moored firmly, head and stern, close alongside each other, and the upright shaft rising between them about midships, the men place themselves at the bars or levers, and move round from one boat to the other, the two giving them a safe and convenient platform. By a simple contrivance, the levers are occasionally shifted upwards, as the screw and shaft sink into the ground.

When the number of men employed can no longer force the screw around, the levers are removed and the shaft drawn out of the ground, leaving the mooring firmly imbedded, with the chain attached to it; a buoy being shackled to the other end of the chain, the work is completed; the time required for the whole operation seldom exceeding a few hours.

These moorings have been placed in every description of ground—rock not excepted; and the qualities which entitle them to the patronage of the public are, perfect security to shipping, great economy, and an entire freedom from the many objections to which other moorings are liable. On these subjects, however, we shall not enlarge, but refer to the letters and testimonials hereto annexed, which have been selected from a great number of documents received on the subject.

Any communications addressed to Alexander Mitchell & Son, engineers, 2 Alfred street, Belfast, shall receive prompt attention.

We have the honor to be, sirs, your very obedient servants,

ALEXANDER MITCHELL & SON.

Lieuts. JENKINS and BACHE,

United States Navy.

---

Extract from the report of Captain Canfield, Corps of Topographical Engineers, to Colonel Abert, dated October 1, 1851, and printed as part of Senate Document No. 1, of the present session, (1851-'52.)

As there is only one burner or lamp in this apparatus, it is evident that any accident by which the lamp was put out would leave them in total darkness; differing essentially in this respect from the common reflecting lights, where, if several lamps go out, there will still be a light of some kind. To make it certain that the light is kept burning, it is usual to keep a watchman constantly with the light.

As a substitute for the watchman, and that the keeper may know immediately of any accident of this kind, I have fixed a contrivance at
Waugoshance, by which the fog-bell will commence ringing as soon as the light is put out.

This is effected by making use of the expanding and contracting power of a copper tube, when heated and cooled. The tube is made to form a part of the chimney of the lamp.

The amount of the expansion under this heat is very small, (about one-twentieth of an inch.) But the expansive force being very great, I use a lever, with a short fulcrum running from the lamp at the centre to the side of the lantern, and increase the amount of the movement here ten times. To the end of this lever is attached a copper wire, which wire is also attached to another lever on the floor of the bell machine, forty feet below the lantern.

The movement by this second lever is again increased six times; so that the motion here amounts to full three inches.

This last lever, when the copper tube is heated by the lamp, is in a position to hold an iron hook, so that the hook will catch one of the spurs of the wheel which moves the clapper-shaft.

The catching of the spur, of course, stops the machine; when the light goes out, the copper tube of the chimney cools and contracts. The lever at the machine is raised, and the hook by its own weight swings clear of the spur of the wheel, and the machine moves on, and the bell rings; and, unless it is stopped, continues to ring until the machine runs down.

This arrangement is found to answer perfectly, and is tested every morning when the light is put out.

---

Communication from the Fifth Auditor of the Treasury, as to the propriety of erecting certain light-houses, for which appropriations were made by the act of 14th August, 1848.

March 15, 1849.—Submitted by Mr. Davis, of Massachusetts, and ordered to be printed.

Treasury Department, Fifth Auditor's Office,
December 15, 1848.

SIR: Having doubts as to the propriety of erecting some of the light-houses for which appropriations were made in the bill passed 14th August last, I availed myself of the second section of the bill to call upon the Secretary of the Navy to detail officers of that Department to examine the several sites, and report their opinion as to the expediency of erecting the buildings, viz:

In Massachusetts and New York.—At the mouth of Parmet river, (Truro, Cape Cod,) Wing's Neck, Buzzard's bay, Massachusetts; North Brother, near Hurl Gate, New York.

For the examination of these, Commander George F. Pearson was designated by the Secretary of the Navy.

In Maryland and Virginia.—At Blackstone's island, (Potomac river;) Sand Shoal island, (on the coast of the eastern shore of Virginia.)
For the examination of these, Commander Franklin Buchanan was appointed.

_In North Carolina._—Cape Fear river: At the Upper Jettie, Campbell's island, Orton's point, Horseshoe, Price's creek, Oak island.

For the examination of all these, Commander Wm. H. Gardiner was appointed.

_In Louisiana._—A floating light on Ship shoal, (near Dernier island.) A floating light in Atchafalaya bay.

For these, Commander George N. Hollins was appointed.

_In Michigan and Wisconsin._—A beacon-light near Mammajuda island, and a beacon-light at Grass island, in Detroit river. A light-house at Port du Mort, and a light-house at Port Washington—both in Wisconsin.

For the examination of these sites, Commander Stephen Champlin was appointed.

These several officers have reported in favor of erecting all the lights which were submitted to them respectively.

Proposals have been invited for building the floating lights for Ship shoal and Atchafalaya bay, in Louisiana, and the one authorized for Cockspur knoll, in Savannah river, has been built, and is now on her way to that station. Of the several light-houses authorized by the above-mentioned act, proposals for building the two in Detroit river, and two on Oak island, at the entrance of Cape Fear river, at both which places the land belonged to the United States, have been invited by public advertisement. In relation to all the others authorized by the act, with the exception of the North Brother island, the superintendents have been instructed to purchase the proper sites, if they could be obtained on reasonable terms, and forward the deeds for the opinion of the Attorney General as to their validity. Until this is done, and the favorable opinion of the Attorney General is received, together with acts ceding jurisdiction by the several States in which the lights are authorized, no step can be taken for erecting the buildings.

I would respectfully recommend that the joint resolution of 11th September, 1841, requiring the opinion of the Attorney General, as to the validity of titles to land acquired by the United States, be repealed, as it is calculated to embarrass and delay the public work, and answers no useful purpose whatever. The resolution directs that no money shall be paid for land until the opinion (favorable) of the Attorney General shall be obtained; and the parties from whom we purchase will not execute the deeds until the money is ready to be paid to them, so that, in point of fact, we are obliged to violate the law before we can send the deed to the Attorney General, who has, after all, to rely upon the opinion of the attorney whom we employ to examine and decide upon the title in the State where the land lies.

In respect to the light authorized on the North Brother, near Hurl Gate, New York, the opinion of Commander Pearson, who was detailed to examine it, was favorable to its erection, but on application to the owner of the island, Mr. Edward Ackerson, for the purchase of a site of two acres, the collector at New York learned that he was indisposed to sell less than the whole island of fifteen acres, for which he asked $9,000, but would take $5,000 for two acres.
This price was considered so unreasonable, taken in connection with a report of B. F. Isherwood, Esq., an engineer of the Navy Department, whom I had sent to examine the light-houses in the New York district, against the erection of a light at this place, in opposition to the opinion of Commander Pearson, as to induce me to instruct the collector to take no further steps in the case without the further direction of Congress on the subject. A copy of the report of Mr. Isherwood, as well as that of Commander Pearson, are here-with submitted, marked B and C.

By the act of the 8th April, 1848, entitled "An act to change the location of certain light-houses and buoys," the light-house authorized to be built on Teller's point, on the North river, New York, was transferred to Tarrytown point, on the same river.

The appropriation in this case was $4,000. The collector and superintendent at New York was directed, soon after the passage of the act changing the location, to purchase the site, if it could be had at a reasonable rate. On consulting the pilots and captains of steamboats, the collector learned that it was the general opinion of those persons that the light, instead of being put upon Tarrytown point, should be placed upon Beakman's point, about two miles distant from where the law placed it, and for the site of two acres the owner asked the enormous price of $3,000. Nothing further, of course, has been done. A copy of the collector's letter, marked A, is here-with enclosed for the consideration of the committee.

Having instituted an inquiry as to the proper site to which the light-house and keeper's house on Amelia island ought to be removed, as provided for by the light-house law of the 14th August last, the superintendent at Jacksonville, Florida, transmitted to me conflicting opinions of pilots, a captain of a revenue cutter and himself, as to the propriety of removing the light. Copies of these opinions are here-with enclosed, marked D, E, and F. It being thus doubtful whether the light ought to be disturbed, I have concluded to take no further step in relation to it.

I take occasion to enclose a letter from Mr. Lawrence, and one from A. H. Norris, Esq., an engineer at New York, who was appointed to oversee the building of the light-house upon Execution rocks, (marked G and H,) showing the progress made with that work down to the 4th instant. This work ought to have been completed, agreeably to the contract, on the 1st August last; but the contractor, having neither skill nor means to carry on the work, has induced gentlemen at New York to join him in the undertaking, who possess both. It is expected that the work will be finished by the 1st January, or very soon thereafter, if the weather should prove favorable.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

Hon. John A. Dix,
Chairman of the Committee on Commerce, U. S. Senate.
LIGHT-HOUSE PAPERS.

LIGHT-HOUSE ESTABLISHMENT.

Letter from the Secretary of the Treasury, transmitting a communication from the Fifth Auditor of the Treasury, showing what has been done under the provisions of the acts of 14th August, 1848, and 3d March, 1849, for building light-houses, light-boats, &c.

December 31, 1849.—Laid upon the table, and ordered to be printed.

TREASURY DEPARTMENT, December 31, 1849.

Sir: I have the honor herewith to transmit a communication from S. Pleasonton, Esq., the general superintendent of the Light-house Establishment, showing what has been done by that officer in pursuance of the acts of Congress of the 14th August, 1848, and 3d March, 1849, for building light-houses, light-boats, &c.

I am, very respectfully, sir, your obedient servant,

W. M. MEREDITH, Secretary of the Treasury.

Hon. HOWELL COBB,
Speaker of the House of Representatives.

TREASURY DEPARTMENT,
Fifth Auditor’s Office, December 29, 1849.

Sir: In continuation of the report which I had the honor to submit to the honorable Committee on Commerce of the Senate, under date of the 15th December, 1848, in relation to the execution of the law of the 14th August, 1848, entitled “An act making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same,” and which report was printed by order of the Senate at the special session in March, 1849, and numbered one, I now proceed to detail what has been done under the several appropriations, beginning with

Massachusetts.

For a light-house at Parmet river, Truro, Cape Cod, the sum of $3,500. This light-house has been built by contract and put into operation for the sum of $3,330.23.

For a light-house at Sankaty Head, Nantucket, the sum of $12,000. This light-house has just been finished in a superior manner, under the superintendence of Benjamin F. Isherwood, Esq., a talented engineer of the Navy Department, at an expense of $10,333. It is to be lit with French lenses of the second order, which were provided under a distinct appropriation, so soon as the superintendent shall give one month’s public notice, which he has recently been directed to do.

For a light-house at Hyannis, $2,000. With much difficulty a small piece of land was purchased, a small tower erected and fitted up with lamps and reflectors, for the sum appropriated. A man has been employed to attend it, who has a house of his own in the neighborhood, at the rate of fifteen dollars per month.
For a light-house at Palmer's island, near New Bedford, $8,500. Built for the sum of $8,416, and put into operation some months ago.

For a light-house at Wing's neck, Buzzard's bay, $8,500. This light has also been built for $8,251, and put into operation.

CONNECTICUT.

For a light-boat at Bartlett's reef, (appropriation made in the general appropriation bill of 14th August, 1848,) $12,000. A vessel of 145 tons has been built and moored at the station for $10,751, and the old vessel previously there, of small dimensions, has been transferred to Eel Grass shoal, for which $5,000 were appropriated; and this latter sum has therefore been saved and will be carried to the surplus fund.

NEW YORK.

For three small lamps on Hudson river, $150. These lamps have been provided and lit at an expense of $116.

For a light-house on the North Brother, near Hurl Gate, $10,000. For the proceedings under this appropriation I respectfully refer to the report from this office to the Senate, before referred to, dated 15th December, 1848.

PENNSYLVANIA.

For a light-house on a pier in the Delaware river, near Fort Mifflin, $5,000. The pier in this case has been repaired, the light-house built and put into operation, for the sum of $4,868 75.

MARYLAND.

For a light-house on Blackstone's island, in the Potomac river, $3,500. The Navy officer sent to examine this site reported in favor of it, but a difficulty has occurred in obtaining the title, which has not as yet been overcome.

VIRGINIA.

For two light-houses on Sand Shoal island, to range with the channel of Sand Shoal inlet, $10,000. The commander in the Navy who was appointed to examine this site, reported in favor of building both lights; but I have been unable to obtain a satisfactory title to the land, and consequently nothing has been done towards the erection of the buildings.

NORTH CAROLINA.

For a beacon on the upper jetties, in Cape Fear river, $8,500. The jetties have been found to be too much decayed to put any building on it; and to build a wharf or dock on which to place a beacon, in 20 feet water, as would be necessary, would cost some twenty-five or thirty thousand dollars. The work has consequently been abandoned.

For a beacon on Campbell's island, in the same river, $8,500. A
contract has been entered into for the erection of this light-house, at a
cost of $3,382, and to be completed on the 10th January ensuing.

For a light-house at Orton’s point, on the same river, $3,500. This
light-house, also, was to have been built under a contract for $3,280, and
to be completed at the same time as that at Campbell’s island.

For a light-boat at the Horseshoe, near Price’s creek, on the same
river, $10,000. Instead of building a light-boat for this place, it is my
purpose to transfer to it a light-boat which has for several years been
moored on the Brandywine shoal, in the Delaware bay, whenever the
light-house authorized to be rebuilt there by the act of the 30th June,
1834, by the Topographical bureau, shall be completed by it; and thus
will be saved the appropriation of $10,000, above stated.

For two beacon-lights at Price’s creek, on Cape Fear river, $6,000.
The sites for these beacons have been purchased, a deed obtained and
laid before the Attorney General, under the joint resolution of August
11, 1841. Nothing further can be done until his favorable opinion shall
be obtained.

For two light-houses on Oak island, at the entrance of Cape Fear
river, $9,000. The land at this place belonging to the United States,
these beacons were built without delay, and are now in operation, for the
sum of $8,984 89.

GEORGIA.

For a light-boat off the Knoll, near Tybee island, Savannah river,
$10,000. This vessel has been built and moored at the station for
$7,585 63.

MISSISSIPPI.

For a light-house on west end of Ship island, $12,000. The site has
been selected, but it was found the land was in dispute, which was
pending in a court at Jackson, the seat of government of the State.

LOUISIANA.

For a bug-light at Proctorsville, Lake Borgne, $500. The appropria-
tion being insufficient, nothing has been done in the case.

For a light-boat at Ship shoal, near Dernier island, $15,000. This
vessel has been built and sent to her station for the sum of $12,774 67.

For a light-boat at Atchafalaya bay, the sum of $12,000. This vessel
has also been built, sent to her station, and moored, for $7,992 79.

WISCONSIN.

For a light-house at Port du Mort, Lake Michigan, $3,500. This
light has been built and put into operation for $3,125 80.

For a bug-light on a pier at Milwaukee, the sum of $500. A small
light has been placed upon the outward end of the pier for $195 66.

For a light-house at Port Washington, $3,500. The light-house has
been finished and put into operation for $3,380 60.
MICHIGAN.

For two beacons on Detroit river, at Mamajuda and Grass island, $7,000. These beacons have been built and lit for the sum of $4,589.

On the 3d March, 1849, another act was passed, entitled "An act making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes."

Under the second section of this act, the Secretary of the Navy was requested to appoint officers of the Navy, of a grade not below that of commander, to examine and report upon the expediency, or otherwise, of erecting lights at the following places, viz:

IN MAINE.

At Gilkey's harbor, for which $3,500 were appropriated.
At Beauchamp's point, for which a similar appropriation was made.

For the examination of these sites, Commander George F. Pearson was appointed, who reported in favor of the erection of both buildings.

Accordingly, the sites have been purchased, and the deeds transmitted to the Attorney General for his approval, previous to the receipt of which nothing can be done towards the erection of the buildings.

NEW YORK.

A beacon on the southeast part of Romer shoal, for which $10,000 were appropriated.

For the examination of this site, Commander William L. Hudson was appointed, who approved of the erection of the beacon; but, instead of $10,000, $40,000 will be required to place such a beacon there as will be necessary. It is respectfully recommended, therefore, that $30,000 more be appropriated. Plans and estimates have been prepared for the execution of the work, in anticipation of a further appropriation.

A light-boat on Horseshoe reef, in Niagara river, $10,000, or, for the erection of a light-house instead thereof, $20,000.

Commander Bigelow was appointed to examine this position, and to report upon the expediency of erecting one or the other of these lights. He reported in favor of a light-house on Horseshoe reef, at an estimated cost of $45,000. It was afterwards found, however, upon inspecting the map jointly formed by the English and American commissioners of the boundary between the possessions of the two countries, deposited in the Department of State, that Horseshoe reef was within the jurisdiction of Great Britain. The parties interested, I understand, will, through the Department of State, seek permission from the British government to erect the light-house. In case permission should be granted, a further appropriation will be necessary of $25,000.

MICHIGAN.

A light-house at the mouth of Muskegon river, for which $3,500 were appropriated.

A light-house at the North Black river, on Lake Michigan, for which a similar appropriation was made.
A light-house at Eagle harbor, Lake Superior, $4,000.
For the examination of these several lights, Commander Bigelow was appointed also. He reported in favor of building the first and last; and, as the land at both places is believed to belong to the United States, the Commissioner of the Land Office has been requested to reserve a small quantity at each place for the accommodation of the buildings. I shall probably have it in my power to erect these buildings in the course of the ensuing summer.
The mouth of North Black river being closed, there is no occasion for a light there at present; and none is recommended by Commander Bigelow.

TEXAS.
A light-house at Sabine Pass, for which $7,500 were appropriated.
Commander Henry A. Adams was selected by the Secretary of the Navy for the examination of this site, and has performed that service, and reported that "the coast is so free from danger in that vicinity, the place itself is so easy of access, and the business done there so inconsiderable, that, in my opinion, a light-house is not necessary there at this time."
In regard to the following lights, provided for by the same law, it was not considered necessary that Navy officers should examine them. The necessary instructions have, therefore, been given to the several superintendents to give effect to the law, as follows:

MASSACHUSETTS.
For a screw-pile beacon, or other practicable structure, on the South shoal off Nantucket, lately discovered by a survey of the coast, $25,000.
This work was placed by law in the hands of the Topographical bureau.
For a light-boat on Pollock rip, off Chatham, $12,500. This boat has been built and moored at her station for the sum of $11,170.

NEW JERSEY.
For a light-house on rocks at Bergen point, $5,000.
For a light-house at the mouth of Passaic river, $5,000.
For a light-house on the east side of Maurice river, $5,000. These several lights have been built and in operation for several months past.

DELWARE.
For a light-house on the breakwater, $10,000. The breakwater has been raised a distance of six feet, and a substantial light-house and dwelling, united, put upon it for $9,925. It has been made a deep red light, to distinguish it from the beacon-light on Cape Henlopen, which is a white light.

TEXAS.
For a light-boat on Galveston bar, $12,500. This vessel has been built and sent to her station for the sum of $11,000.
ILLINOIS.

For a light-house on the pier at Chicago, $15,000. For a light-house at the mouth of Calumet river, $4,000. These two lights were placed by law under the Topographical bureau.

MICHIGAN.

For a light-house on Manitou island, in Lake Superior, $7,500. This light has been built and put in operation for $7,440.

For a floating bell at Standard rock, $1,000.

The appropriation is much too small to accomplish the object, if it should even be practicable to moor a vessel with a bell there. A change of collectors at Mackinac, and the short season of navigation on Lake Superior, have put it out of my power hitherto to obtain satisfactory information in regard to this rock and the waters surrounding it. When the season of navigation shall recur, this information will be sought, and, it is hoped, will be obtained.

For a light-house on Skilligalee rock, in Lake Michigan, $4,000. Concerning this rock, also, the causes above stated have deprived me of information as to its fitness for such a light-house as the small amount appropriated would build, and as would answer the purpose of commerce. Proper attention will be given to the subject on the opening of navigation in the ensuing spring.

For a beacon on a pier at New Buffalo, $750. This beacon has been placed upon the pier at an expense of $475.

It is proper to remark that the two light-houses in Texas, at Bolivar point and Matagorda island, for which appropriations were made by the light-house act of the 3d of March, 1847, have not been built. The sites were selected and purchased in that year, and the legislature of that State was called upon soon afterwards to cede jurisdiction over them as required by the act of Congress; but, from some oversight, the legislature adjourned without consummating it, not to meet again until the present winter. In the meantime, the appropriations made by Congress have been carried to the surplus fund. Hence it will be necessary that these appropriations be revived, if it be intended to prosecute the work, of which no doubt can be entertained.

Having reviewed all the appropriations in detail, made by the two acts of the 14th August, 1848, and 3d March, 1849, for building light-houses, light-boats, beacons, and buoys, and stated what has been done in relation to each of them, I have added, in the subjoined table, a condensed view of the cost in each case, and the sum remaining to be carried to the surplus fund.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

Hon. WILLIAM M. MEREDITH,

Secretary of the Treasury.
Letter from Professors Peirce, Lovering, and Horsford, of Harvard University, Massachusetts.

Cambridge, January 9, 1850.

We have examined with some care the drawings of Mr. Wilson and Dr. Meacham, and the method which they are intended to illustrate of improving upon the light-houses in the United States. It is well known that the light-house system of this country is at present very defective and compares very unfavorably with those of foreign countries, particularly France. At the same time it must be apparent that the commercial interests of the country, as well as the safety of all who navigate our waters, will be seriously affected by the character of the lights which are stationed along our coast, and in our rivers and lakes. On this account we believe that any proposition to improve upon the existing system, which combines simplicity and a great economy with that degree of efficiency which should characterize all the operations which aim to protect our large commerce, is deserving of a deliberate hearing and of a fair experimental trial. The plan of Messrs. Wilson and Meacham has impressed us favorably in this respect, and we believe that any gentlemen who have the ability to assist them in an experiment which is beyond the means of a single individual, will have done much towards furnishing the protection so much wanted, and deserve the gratitude of the community.

No portion of the country is more interested in the subject than this community, and none, probably, could be appealed to in any question of public interest with better prospects of success.

BENJAMIN PEIRCE.
JOSEPH LOVERING.
E. N. HORSEFORD.

Treasury Department, December 19, 1850.

Sir: I have the honor herewith to transmit a report from S. Pleasonton, Esq., the general superintendent of the Light-house Establishment, dated the 14th instant, showing the mode of supply, inspection, general condition, and extent of the establishment, &c.

I am, very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Hon. Howell Cobb,
Speaker of the House of Representatives.

Treasury Department,
Fifth Auditor's Office, December 14, 1850.

Sir: In the management of the light-house establishment, besides an examination of the lights annually (in June or July) by the several collectors, who are charged with the superintendence of them, and a report
of their condition made to this office, the captains of the vessels which are employed to convey and deliver the oil, tube-glasses, buff-skins, &c., to the light-houses on the Atlantic coast annually, are required not only to report the repairs deemed necessary at each light-house, but also the repairs they may cause to be made to the apparatus by means of lamp-makers whom they carry with them. These captains are furnished with the necessary quantity of oil, with lamps and reflectors, and parts of lamps, with tube-glasses, wicks, buff-skins, oil butts, &c., to maintain efficient lights in the several houses during the ensuing year. They are required to obtain the receipts of the respective keepers for the oil and all other things delivered, and to transmit them to this office with their reports.

These vessels commence their deliveries in April or May of each year, in the State of Georgia, and proceed eastward, finishing their duties in September. In October, or early in November, one of them proceeds with oil and other things, as in the other case, to Florida, and finishes the deliveries in Louisiana.

For the light-houses on the northern lakes, oil and other articles necessary to keep them lit are sent from Boston to Buffalo, Oswego, and Plattsburg, as early in the spring as the several canals are navigable. Those sent to Buffalo are shipped on board a vessel chartered for the purpose, placed under the care of and to be delivered at the respective light-houses, by the general inspector of lights for Lakes Erie, Huron, Michigan, and Superior. He takes with him a lamp-maker to make the necessary repairs to the lighting apparatus. He is also required to report the repairs necessary at each light, and to obtain and forward the receipts of the keepers for all the articles delivered. The collectors at Oswego and Plattsburg, acting as superintendents, cause the articles sent to them to be distributed on Lakes Ontario and Champlain, in like manner, and report the condition of the buildings and lights.

I have received the reports of the two Captains Howland, of the state of the lights on the seaboard from Georgia to Maine, inclusive, for the present year; and the report of the general inspector on the upper lakes; of all of which I have the honor herewith to send copies. These reports refer to repairs not then generally made, but which have been subsequently made. The report respecting the lights from Florida to Louisiana has not been received. When received it will be forwarded.

I preferred sending the reports from the captains of the supply vessels to those of the superintendents, as being more concise, and affording information as to the delivery and consumption of oil which the others would not show.

It will be perceived that very few keepers consume the same quantity of oil; some consuming less than 30 gallons, and others more than 40 gallons per lamp. When the consumption exceeds 40 gallons, inquiry is instituted to ascertain the cause, which is generally found to be in the recent appointment and consequent ignorance of the keepers of the proper mode of managing their lamps and ventilating the lanterns. The average consumption on the seaboard is about 35 gallons per lamp annually; and on the lakes, where the light is suspended during the winter, about 27 gallons per lamp.
Captain Howland, in some instances, mentions that the mortar with which the towers were built appeared to be nothing but sand, which crumbled and fell from the joints in buildings erected of bricks or stone. He was not aware of the fact that when these towers were built, it was the prevailing opinion of builders, as well as of this office, that the mortar made of common lime and sand ought to be mixed with fresh water and fresh sand, and consequently all the contracts prior to 1843 provided that the mortar should be so made. In that year, however, finding on the eastern coast that the mortar in towers built near the sea in a few years was decomposed, crumbled, and fell from the joints, an inquiry was instituted, when it was found that the muriatic acid in the air, arising from the sea, was the cause of the destruction of the mortar made with fresh water and sand. A report upon the subject was made by this office to the Committee on Commerce of the House of Representatives in February, 1843, and printed. It will be found in Doc. No. 282 of the 3d session of the 23d Congress.

The light-house establishment at this time consists of 331 light-houses and 40 light-ships, a large number of dumb beacons, and about 2,500 buoys. Of the light-houses 270 have been built under the direction of this office, as well as all the light-ships and most of the buoys.

By advertising for proposals for all work, and accepting the lowest bid, and paying nothing until the work was satisfactorily done, as has always been done by this office, I have saved of the several appropriations for building light-houses between the years 1820 and 1842, amounting to $1,248,708 38, the considerable sum of $224,216 45, and caused the same to be carried to the surplus fund. And in building light-ships, within the same period, out of appropriations of $859,600, the sum of $59,121 21 was in like manner saved and carried to the surplus fund. This will be seen by reference to the report of the Committee on Commerce, H. R., 2d session 27th Congress, numbered 811.

Subsequently to this period no appropriations were made for building light-houses or light-ships until the year 1847. Appropriations for building lights were made on the 3d of March of that year, amounting to $501,250, partly to be expended by this office, and partly by the Topographical Bureau. So far as expended by this office, the sum carried to the surplus fund amounted to $40,017, 94. (See report, 1st session 30th Congress, No. 27, House of Representatives.) Of the appropriations made for building light-houses and light-ships in 1848 and 1849, the sum of $24,050 78 was saved and carried to the surplus fund. It results, therefore, that in building light-houses and light-vessels I have saved, since I have been charged with that duty, the considerable sum of $347,434.

But this is not all. Whilst the British light-houses cost for their maintenance an average of from $3,300 to $3,600 per light, ours cost upon an average from $1,100 to $1,800 each; and they have more small lights, in proportion to the whole number, than we have. If this difference in expense be applied to the whole of our extensive establishment for years past, it is obvious that several millions have been saved in the administration of the light-houses and light-ships of this country.

There is about the same difference in the expense of maintaining the
floating lights of the two countries. The average expense of maintaining the British floating lights is stated, in their returns laid before Parliament, to be some years $7,660 and $7,900, whilst ours is from $2,500 to $2,900 each.

The law of 28th September last, authorizing the building of light-houses and light-ships, was passed too late in the season to do more than detail officers of the revenue service to examine and report upon the expediency, or otherwise, of erecting the buildings. They have not yet reported, with the exception of the one on the northern lakes, who has made a partial report only; being unable, in consequence of the close of navigation upon Lake Superior, to visit the sites upon that lake. This he proposes to do on the opening of navigation in the spring.

There is great danger of having too many lights. On a part of the eastern coast complaints have been made by navigators that there are more lights than can be distinguished one from another. Hence, the officers sent have been directed to examine and report upon the expediency of erecting any and all the lights contained in the law.

No complaint has reached me of the inefficiency of any of our lights on the seaboards or lakes, by navigators, merchants, or underwriters. They are reported to be seen as far as British lights of the same class. This, indeed, was proved before a committee of the House of Commons in 1845, whose report is in my possession. They called before them Captain George Moore, born in England, but trading from New York to London for 23 years, as commander of the ship Henrich Hudson. To the question, “Have you been in any of the (United States) light-houses, and are they done by reflectors?” he replied: “I have been in some of the light-houses, and they are done by reflectors, principally. Our lights (United States) at present are equal to any lights in any part of the world I have ever been in. We are enabled to see our lights at a moment, in any clear weather, when they come above the horizon; the moment they are brought above the horizon we are enabled to see the lights, and no lights can be seen further.”

I have the honor to be, sir, very respectfully, your obedient servant,

Hon. Thomas Corwin,
Secretary of the Treasury.

S. PLEASONTON.

MINOT ROCK LIGHT-HOUSE.

We are gratified in being able to lay before our readers the following distinct and authentic description of the light-house on Minot's ledge:

To the Editor of the Boston Daily Advertiser:

Within the last two weeks, several communications, letters, &c., have appeared in the newspapers relative to the Minot Rock light-house, descriptive of the supposed dangers to which the structure and its inmates are exposed; but, in none of the statements as published, is there anything to be seen which is sufficiently intelligible to enable one to know
what the Minot Rock light really is, or how it has been constructed. If you will allow me the use of a column in your paper, I will endeavor to supply this information.

January 18, 1851.

W. H. S.

Minot's rock or ledge, as many of your readers know, is the outermost of the Cohasset rocks, distant some 20 miles SE. of Boston.

This rock is bare at low water only, or at best at three-quarters ebb, and the utmost extent of surface exposed at the very lowest tide is an area of about 30 feet in diameter, but, in general, 25 feet is all that is uncovered, and even of that extent the sea must be very smooth and the wind off the land.

The nearest point to the shore is distant 1½ mile only, but, seaward, it is entirely open to the Atlantic, and, of course, exposed to all its violence in an easterly gale.

The structure which supports the lantern and the dwelling of the keeper is a truncated pyramid in form, composed of nine wrought-iron piles or shafts, 60 to 63 feet long, one at the centre and eight standing at equal distances from each other in the circumference of a circle of 25 feet diameter, and converging towards the centre at top, where they are attached to a heavy casting, a spider frame, of 14 feet in diameter. The outer piles are 8 inches in diameter at foot and 4½ inches at top, the middle pile is 8 inches diameter at foot and 6 inches at top, and all the piles are swelled to 10 inches diameter at the surface of the rock.

The holes in the rock, into which the feet of the piles are inserted, are 5 feet deep and 12 inches in diameter, and the space between the sides of the holes and the pile is filled with iron wedges and a cement formed of iron filings.

The piles are forged in two pieces each, the surface of the rock being irregular in shape; the lower pieces are of unequal lengths, that is to say, from 35 to 38 feet, according to the position they occupy in the rock. The upper pieces are 25 feet each, and the connection between the upper and the lower pieces is made by a very stout coupling of gun metal, 3 feet long, and weighing about 800 pounds, the inside being nicely bored, and the ends of the piles turned and accurately fitted thereto, and secured together by steel keys passing entirely through the coupling and through each pile.

Between the rock and cast-iron cap, or spider frame, there are three series of wrought-iron braces, radiating in a horizontal direction from the middle pile to the outer pile, and connecting, also, the outer piles, one with another, forming an unbroken net work. The first series is about 20 feet above the rock, and below the coupling of the piles; the second series is 38 feet above the rock, and above the coupling of the piles; the third, or upper series, is about 8 feet below the cap, and forms the support of a store-room for provisions, fuel, oil, &c.; the lower braces are round, 3½ inches in diameter; second, 3 inches; and the upper are 2½ inches square.

Lastly, between the first and the second series of horizontal braces, there
are ties of 1\(\frac{1}{2}\)-inch round iron, extending, diagonally, between the middle pile and each outer pile, and between each pair of contiguous outer piles alternating from head to foot, in each of these spaces, by 32 such ties, between the first and second tier of braces. It was intended to introduce ties of the same kind between the lower series of braces and the rock, and a few of these had been inserted in November last, but the boisterous weather prevented the completion, and it was these last-mentioned ties which were broken or bent in the gale of the 22d and 23d of December last, but without the slightest injury to the structure.

It may be remarked, that the object in placing these ties as described, was to prevent, if practicable, vibration in the structure; it was not expected that these ties would strengthen it in any material manner, and that was not the object in introducing them, because it is plain to be seen that the principle of the screw-pile light requires that the least possible extent of surface should be exposed to the action of the sea; and while there is no question that the upper series of ties, beyond the reach of the sea, does stiffen the structure, it is questionable whether the advantage gained by the introduction of the ties below is not entirely over-balanced by the injurious effect produced by the continually striking of the sea against them.

On the cast-iron cap stands the living-room or dwelling of the keeper. This room is 14 feet from out to out, octagonal in shape, and the posts or uprights at the angles are of cast iron, and are secured to the cap by appropriate screws and bolts; upon the top of this again stands the iron lantern, a polygon of 16 faces, 11\(\frac{1}{2}\) feet in diameter, and 6\(\frac{1}{2}\) feet in height, fitted with reflectors 22 inches in diameter. The glass is French plate, 44 by 24.

Outside of the piles and level with the cap, or floor of the living-room, there is a gallery around the light-house supported by cast-iron arms or brackets attached to the pile heads. This gallery is three feet wide, furnishing a walk around the building, and a lookout.

From this brief description of the Minot light, its situation and the nature of its construction can be understood, it is hoped. This done, it may be considered not out of place to notice some of the statements which have appeared in the newspapers and alluded to in the first part of this communication.

From the manner in which the Minot has been discussed of late, one might suppose the principle of supporting a light on piles to be new, and that the attempt in the case of the work in question had been a rash experiment, undertaken without precedent; to many it is of course known that, on the coast of England, the screw-pile light has been in successful operation some ten or twelve years, and although the construction of the Minot differs somewhat from the English, substantially it may be considered nearly the same thing, the essential principle requiring that the sea shall have no other obstruction in its passage beneath the light than such as may be caused by the piles which support the superstructure.

In England these lights have been built upon sand spits, or shoals, where the foundations have been unstable, and where, to secure the necessary amount of bearing surface for the superincumbent weight,
cast-iron screws or vises from 3 to 4 feet in diameter have been attached
to the foot of the iron piles and screwed into their places by means of
capstans and other appliances. The iron piles again, in the English,
are inserted or otherwise secured to heavy timbers, and thus is combined
of iron and wood, the pile on which the platform is constructed for the
light, &c., to stand upon.

At the Minot, screws are not applicable, the feet of the piles being
imbedded in the rock, and, unlike the English, the piles are of iron
entirely, no timber being introduced, except for the living-room and
store-room.

The question has been asked, why put up such a structure in a situ-
ation so exposed—why not build it of stone? The reply is obvious: such
lights can be built at comparatively a small cost, and in most situations
in a short period of time. If we would emulate the English or the
French, and would build stone towers like the Cordouan, the Eddystone,
Bell Rock, or Skerryvore, &c., we must be prepared to pay for such mag-
nificent structures; that is to say, while the simple and rapidly-constructed
screw pile may cost from $30,000 to $50,000, the great works enumer-
ated have cost from $250,000, the least, to $500,000, the greatest, and
the last built. It is very clear that, while we might indulge ourselves
in one or two of these magnificent works, we could not undertake to
build many, notwithstanding new light-houses are required on dangerous
reefs and ledges at this time. The cost of the Minot was about $32,000.

The true question in the case is this: is the Minot safe, if not, can it
be made safe?

The light is now in its third winter; a simple pile only was placed in
the autumn of 1847. In the season of 1848, all the piles, the cap, and
the braces were put up, but nothing was done towards erecting the house
or the lantern, as the entire season was consumed in drilling the holes
into the rock for the piles. It was left, in fact, in an unfinished condi-
tion through the winter of 1848, without its full complement of keys
and wedges. During the year 1849 the work was completed, and on
the 1st January, 1850, it was lighted, and since that time the light has
been regularly occupied. The reply to the first part of the question
therefore is, that the structure is now in its third winter, as before
stated, and it may thence be inferred that it is safe.

The statement made, that the rock is split, is one well calculated to
create alarm; and if the plan of the structure were not understood from
the preceding description a doubt might be produced, and a conviction
follow, that, with a split in the rock, the building must necessarily fall.
To this it is said—

First. It will be remembered that the light stands upon nine legs,
each inserted in a hole 5 feet deep in a granite rock.

Second. That by the latter, a slope given to the outer piles of 1 2-10
inches to the foot, and by the position of the horizontal braces of 3 3-
inch iron, that the whole structure acts like a Lewis, and that it cannot
be overthrown, unless the body of the structure, that is the house itself,
be within the reach of the sea—the surface opposed by the piles alone
being entirely too small in extent to offer a tithe of the obstruction
necessary to produce such a result. Again, the piles and braces being
supposed to have the requisite degree of strength, it is clear that these holes in the rock must be broken out by the piles before the structure can be overturned.

Finally, the rock is not split, and the natural fissure which shows itself is precisely as it appeared when the rock was first examined, in 1847. The light could not come down even if there were just such a split as has been imagined.

The remedies which have been suggested for the supposed errors in the construction of the Minot are somewhat amusing. One is, to build within the iron piles a kind of Eddystone, junior, viz: granite blocks secured to the rock. Rather costly it might prove. Perhaps a better mode, if the Eddystone principle is to be introduced, would be to make a tower having the elements of strength within itself, without resorting to the iron piles to keep it in its place. The proposed form, that is, the bow of a ship looking seaward, is novel, certainly.

It is not set forth whether this plan contemplates a tower capable of being turned upon its centre in such a manner that the "face to the sea, like the stem of a ship," can, in case of need, be pointed in any other direction than E. NE. If there be no such arrangement provided, it may happen sometimes that a heavy sea from E. SE. would affect disadvantageously this "face."

Another remedy, it is said, has actually been adopted, but it appears so improbable that such a gross violation of common sense could be committed or sanctioned, that we are inclined to suppose this, like the first, to be a suggestion only, viz: that a guy or hawser has been fastened to a small rock a few feet outside the Minot, and that the other extremity is attached to the upper part of the light-house, to prevent the structure, as alleged, from being overturned. It needs no Solomon to perceive that the effect of the sea upon this guy is precisely that which a gang of men would exert if laboring at the rope to pull the light-house down.

We have understood that those who think the Minot unsafe have been brought to that conclusion by the destruction of the beacon which was erected on the Londoner rock, near Thatcher's island, some three years since, believing or ascertaining the structures to be alike in construction; this is not the case. We know nothing of the manner in which the beacon on the Londoner was put up, nor is that material to the question. We know that the beacon itself was an exact copy of that which was erected at Black Rock harbor, in Long Island sound, in 1843, and which for that place has answered perfectly well, as the experience of seven winters has proved; but we also know that a work suitable in all respects for Long Island sound may be entirely unfit for the Atlantic ocean. The explanation in this case is very plain. The whole height of the beacon was 36 feet. Of this we are to suppose that at least 3 feet was inserted in the rock. The cage at the top of the beacon was made of boiler iron, in strips of 2 inches in width, and the cage was 4 feet in diameter and 9 feet in height. The bottom, therefore, of this cage must have been within 12 feet of the high-water line. Hence, it is easy to perceive that a very slight sea must run over the top of the beacon, and as a consequence be overthrown. The cases are entirely unlike; at the Minot the living-room, the cellar, &c., are entirely beyond
the reach of the sea, while at the beacon the whole of the cage must at times have been submerged.

There is one other point to which we wish to call attention, and there, for the present, allow the subject to rest. We allude to the destruction, in 1849, of the light-house which was in course of construction at Bishop’s rock, on the south coast of England.

In the newspaper account it was stated that while the building was in progress the whole work was swept from the rock in a gale of wind, but by the same account it appears that the important principle of the screw-pile light had been disregarded in the construction, that is to say, instead of the common pile at the centre, there had been introduced a cast-iron column, 3½ feet in diameter, to serve as a stairway. It is clear that this large surface exposed to the fury of the wave would necessarily lead to the destruction of the light, for it is difficult to conceive how any such hollow column could be made to withstand the shock of the sea. And even if it were solid, an immense quantity of superincumbent weight would be necessary to preserve it from being overthrown by the waves. In short, there is nothing in the account, as given in the newspaper, which should, in any degree, impair confidence in the stability of the screw-pile light when it is put up in a proper manner.

In conclusion, it may be remarked that there is one very prominent fact, and one not to be overlooked in this discussion, to wit: that the Minot light has now been up two entire winters, and the half of another. Since it has been built, there have been storms of as much violence, perhaps, as in former years, still the work stands in its place. It had not, in November last, when examined, moved one inch from the position it originally occupied; not a joint had been started, not a brace broken, nor had the structure received the slightest injury from the storms and the ice; three of the iron rods or ties, which were partially put in place in November, have been broken or bent. As before stated, this happened because the collar to which they were attached slipped upon the pile, a matter of about as much importance, so far as the stability or safety of the structure is concerned, as would be the stripping of half a dozen ratlines from the shrouds of a vessel. It is not said that the screw-pile light is a structure as rigid as a stone tower, nor is it intended to be intimated that if we had the choice at equal cost between the Eddystone and a screw pile, that we would not choose the former; the question in such a case would be this: If a light-house can be built on the Minot, which can be made to stand securely in its place, for, say, $40,000, would it be wise to expend $200,000 or more for a stone tower? The answer, we think, is obvious. If it can be made safe, build the pile light; if it cannot be made safe, build the tower. Time, the great expounder of the truth or the fallacy of the question, will decide for or against the Minot; but inasmuch as the light has outlived nearly three winters, there is some reason to hope that it may survive one or two more.
AN ACT making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.—

(Statutes at Large, vol. 9, p. 564.)

SEC. 6. And be it further enacted, That hereafter all buoys along the coast, or in bays, harbors, sounds, or channels, shall be colored and numbered, so that in passing up the coast or sound, or entering the bay, harbor, or channel, red buoys with even numbers shall be passed on the starboard hand; black buoys with uneven numbers on the port hand; and buoys with red and black stripes on either hand. Buoys in channel-ways to be colored with alternate white and black perpendicular stripes.

* * * * *

Approved September 28, 1850.

AN ACT making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.

* * * * *

SEC. 7. And be it further enacted, That hereafter, in all new light-houses, in all light-houses requiring new lighting apparatus, and in all light-houses as yet unsupplied with illuminating apparatus, the lens, or Fresnel system shall be adopted, if, in the opinion of the Secretary of the Treasury, the public interest will be subserved thereby.

SEC. 8. And be it further enacted, That the Secretary of the Treasury be, and he is hereby, authorized and required to cause a board to be convened at as early a day as may be practicable after the passage of this act, to be composed of two officers of the Navy, of high rank, two officers of engineers of the Army, and such civil officer of high scientific attainments as may be under the orders, or at the disposition of the Treasury Department, and a junior officer of the Navy, to act as secretary to said board, whose duty it shall be, under instructions from the Treasury Department, to inquire into the condition of the light-house establishment of the United States, and make a general detailed report and programme to guide legislation in extending and improving our present system of construction, illumination, inspection, and superintendence: Provided, That no additional compensation shall be allowed any person serving on said board.

SEC. 9. And be it further enacted, That the President be, and he is hereby, required to cause to be detailed from the engineer corps of the Army, from time to time, such officers as may be necessary to superintend the construction and renovating light-houses.

Approved March 3, 1851.

[From the N. Y. Journal of Commerce, July 9, 1852.]

UNITED STATES LIGHT-HOUSE SERVICE.

By an act of Congress approved March 3, 1851, the Secretary of the Treasury was authorized to cause a board to be convened at an early day, to be composed of two officers of the Navy of high rank, two officers of engineers of the Army, and such civil officer of high scientific
attainments as might be acting under his Department, with a junior officer of the Navy, as secretary to the board, whose duty it should be, under instructions from the Treasury Department, to inquire into the condition of the light-house service of the United States, and to make a detailed report and programme to guide legislation in extending and improving our present system of construction, illumination, inspection, and superintendence. The board consisted of Commodore W. B. Shubrick, as president, Commander S. F. Du Pont, U. S. Navy, Gen. Jos. G. Totten, U. S. Engineers, Col. James Kearney, U. S. Topographical Engineers, Professor A. D. Bache, Superintendent U. S. Coast Survey, Lieut. T. A. Jenkins, U. S. Navy, secretary.

During the past summer this board visited thirty-nine different light-houses and vessels, located between Portland, Maine, and Cape Fear, North Carolina, comprehending all the most important coast lights that index the principal bays, estuaries, and harbors, in this long extent of coast. The result of this inspection is now presented by Congress to the public, in a most elaborate report of 760 pages, illustrated by some 40 plates and numerous wood cuts, and embodies all the scientific and practical information necessary to the clear understanding of this branch of the public service, hitherto so shamefully neglected and viciously managed. The report of this board is by no means the first one of the kind, in which a laudable effort has been made by the executive to penetrate the mysteries of the light-house service, and reform its abuses. So far back as 1833, the fact that our lights were far inferior in brilliancy to the English and French, was noticed by all the best shipmasters navigating across the Atlantic, and in 1837 a memorial setting forth the details of this inferiority, and pointing to its chief cause, was submitted to Congress by Messrs. E. & G. W. Blunt, of this city, who may justly claim to be the pioneers in attempting a reformation, and in advocating the adoption of the European improvements.

From the date of this memorial to the present day, there have been several strong efforts made to abolish our present vitiated system of light-house administration, but without success.

In 1838, a board of naval officers was appointed to examine all the lights, beacons, and buoys, and report their actual condition and the wants of the service. These officers presented a detail of facts, that, under any government but ours, would have commanded the gravest attention, followed by the most decided action.

In 1842, the Secretary of the Treasury appointed a corps of civil engineers to inspect the whole system of lights and report to him in detail; but the light-house administration, alarmed, as is believed, for their official safety, determined that this survey should be stopped, and succeeded in suspending it before one-fourth part of the coast had been examined.

The report that resulted from this partial survey was a severe blow to the defenders of the old system; and if the Government had possessed the proper energy and vigilance, such an array of facts could not have been passed over unnoticed. A most important benefit, however, resulted to the public from the detail of the defective condition of the light-houses, and particularly as to the illuminating apparatus, contained in this report.
of Mr. J. W. P. Lewis; for it compelled the "General Superintendent of Light-houses" to bestir himself, and get things a little more to rights. All the prominent coast lights received new lanterns and apparatus, as fast as the contractor could supply them, and many of the minor lights were similarly renovated. The public mind was also directed to the subject, in consequence of the attacks brought upon Mr. Lewis by his temerity in exposing the actual condition of things; and the subject has by slow degrees begun to assume that importance which so properly belongs to it.

In the report just published by the board, who are individually and collectively beyond the merest suspicion of prejudices or bias of any kind, the array of facts is so strong, the deficiencies pointed out are so numerous, and the glaring inconsistencies so clearly held up to view, that the wonder is how such a gigantic system of abuses could so long have escaped discovery and a speedy extermination. And, yet, the details are for the most part a repetition, on an extended scale however, of the very defects pointed out, first by Messrs. Blunt, next by the board of naval officers in 1838, and, thirdly, in a more explicit and technical form by Mr. Lewis in 1842.

The examinations made by the board extend not only to the construction of towers, dwellings, and illuminating apparatus, but include a careful investigation of the police of the service—the manner in which keepers discharge their duties—the ability and fidelity of the inspectors—the modes of supplying each establishment with oil and other stores—the nature of oil contracts, and the mode of testing oil.

The entire management of the service is then contrasted with the light-house administrations of Great Britain, France, &c. Every source of solid and reliable information seems to have been explored, in order to arrive at a fair and unprejudiced estimate of the merits and defects of our system.

The board recommended, in strong terms, and for reasons sustained by 25 years of European experience, 1st. That a careful system of classification should be adopted, after the French method, which divides its light-houses into six orders of magnitude. This system not only insures the greatest economy in annual maintenance, by adapting the size of the light (and consequently its consumption of oil) exactly to the importance of its individual locality; but is the first and best step towards a thorough designation of the lights, by which is meant, the giving to each light some peculiar characteristic appearance, such as a "fixed light," or a "revolving," or a "flashing," or an "intermitting." It is these distinctions, which, when arranged upon a well-digested system, give to a group of light-houses the character of a night telegraph, that signalizes to the seaman his exact position, and points the way to his port of destination, or warns him how to avoid the dangers of the vicinity.

2. The board recommend the general adoption of the French-lenticular system of illuminating apparatus, invented by the celebrated Augustin Fresnel, who, under the auspices of his government, developed this most beautiful application of science to the wants of navigation, and bestowed upon his fellow men a boon that should rank him with Watt, Fulton, and Morse.
The lenticular apparatus of Fresnel bears the same relation to the old system of illuminating light-houses, by means of small lamps set in silvered "reflectors," that a refracting telescope does to a reflecting telescope.

It is well known to all who have ever given any attention to this subject, that the refractor, or lenticular telescope, is vastly superior to its quondam rival; for, since the art of casting glass of great purity has been attained, the use of reflecting telescopes is no longer common, and they may be considered as obsolete. It is true that Lord Rosse has constructed two, of enormous magnitude, and at a prodigious cost: but the power of his six-feet reflector bears no comparison to that of the light and elegant reflector in Cambridge Observatory, (Mass.,) whose object lens is only sixteen inches in diameter, and the instrument movable with a mere touch of the finger.

Fresnel's system consists of a hollow prism of cut glass, formed by several lenses, (from four to twenty-four lenses, and from eight to forty-eight accessory pieces,) all having one common central focus—in which focus he places a lamp of a size corresponding to the magnitude or order of the apparatus; and he divides his system into six orders, each of which is susceptible of being made to assume five or six different aspects.

The rays of light from the lamp, in their passage through the lenses, are refracted into a horizontal beam, or zone, of intense brilliancy, being distinctly visible to the seaman at distances varying, according to the order of height of the light-house, from ten to forty miles. Nine-tenths of the light from the lamp are economized, and thus refracted.

The old system of illumination by the Argand lamp and parabolic reflector, which also was invented and first applied to light-houses in France twenty-eight years before its introduction into the United States, the amount of light from each lamp that falls upon the reflector, and is then projected to the horizon, is in the very best instruments not more than three-fourths; besides which the absorption of light on the surface of the reflector is equal in any case to 50 per cent. Hence the remarkable superiority of the lenticular system, which may be practically understood by the following simple demonstration of Alan Stevenson, Esq., engineer of the Scottish light-houses, and whose experience dates back fifteen years. Mr. Stevenson says, (in his Treatise on Light-houses, page 121:) "In comparing the fixed dioptric (lens light) and the fixed catoptric (reflector light) apparatus, the results may be summed up under the following heads:

1. It is impossible, by means of any practicable combination of paraboloidal reflectors, to distribute round the horizon a zone of light of exactly equal intensity, while this may be easily effected by dioptric means. In other words, the qualities required in fixed lights cannot be so fully obtained by reflectors as by refractors.

2. The average light produced in every azimuth by burning one gallon of oil in Argand lamps with reflectors is only about one-fourth of that produced by burning the same quantity in the dioptric apparatus, and the annual expenditure is £140 3s. 8d. less for the entire dioptric light than for the catoptric light.

3. The characteristic appearance of the fixed reflecting light in any
one azimuth would not be changed by the adoption of the dioptic method, although its increased mean power would render it visible at a greater distance in every direction.

"4. From the equal distribution of the rays, the dioptic light would be observed at equal distances on every point of the horizon—an effect which cannot be fully attained by any practicable combination of paraboloidal reflectors

"5. There can be but little doubt that the more fully the system of Fresnel is understood, the more certainly will it be preferred to the catoptric (reflecting) system of illuminating light-houses, at least in those countries where this important branch of administration is conducted with the care and solicitude which it deserves." (See Report, page 87.)

The foregoing applies to "fixed" lights. But when the comparison of the old and new systems is applied to revolving lights, the difference in favor of Fresnel is still greater. Any one who has an opportunity to view the lights at the entrance to this harbor, as seen from Staten Island or Fort Hamilton, can judge of this difference. In one group are seen five lights. The two highest are Fresnel lights; the three lower are reflector lights, one of which, Sandy Hook light, is of the first class of "fixed" lights. One of the Fresnel lights is "fixed," the other "revolving." Compare this fixed light, which is of the second order only, and it will be seen to have an apparent magnitude four times as great as the Sandy Hook light, and a brilliancy far superior, though four miles more distant from the observer.

It is entirely unnecessary to institute any present comparisons in this connection to those who have any knowledge of optics; because the whole case lies in a nut-shell, and consists merely in the well-known difference of power between refractors and reflectors, and in all other respects is simply a matter of dimensions.

The other recommendations of the board are directed to the location and construction of light-houses, pointing out the evils arising from the indiscriminate erection of lights before any competent authority had decided upon the merits of the case, and thereby producing a confused medley, entirely unintelligible to the seaman. They also refer, in strong terms, to the necessity or organizing a thorough system of administration, in place of the present bureau, which has exhibited at least a lack of zeal for the adoption of modern improvements.

The publication of this document, so entirely impartial in its character, must satisfy every disinterested person that the need of a reform is urgent. The present gigantic size which our light-house establishment has attained, though yet not half developed, calls for the organization of a permanent board or bureau, composed of men like the present board, whose rank and ability will secure to the country the best results. Let the silver idols of the existing system be torn down from their high places, and give the weary seaman the light of truth and the benefits of science.
Mr. HAMLIN. I move to postpone the prior orders, for the purpose of taking up the bill from the House making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.

Mr. MASON. I hope the Senate will not agree to that, because it is indispensably necessary that we should have an executive session. I have desired for several days to obtain one; and if this motion is now voted down, I shall move to proceed to the consideration of executive business.

Mr. BRIGHT. I hope neither of those propositions will be agreed to, but that the Senate will proceed to the consideration of the homestead bill. [Laughter.] I feel it to be my duty to call the attention of the Senate to that bill, and to insist on its being taken up.

Mr. HAMLIN's motion was agreed to—ayes 34, noes not counted—and the Senate, as in committee of the whole, proceeded to consider the bill.

Mr. HAMLIN. The Committee on Commerce directed me to report this bill, with various amendments. I do not see any necessity that they should be read at length; and as they are not printed, I will offer them separately. The first is to strike out the clause under the heading of Maine—

"For a light-house on the south end of Northern Fox island, at the entrance of Penobscot bay, $5,000;" and insert in lieu thereof: "For a light-house at the easterly end of the thoroughfare between North Haven and Vinal Haven, or Herron Neck, as the Department shall determine, $5,000."

That proposes simply to authorize the Secretary of the Treasury to put a light-house upon the neck instead of another point on the other side of the bay.

The amendment was agreed to.

Mr. HAMLIN. The next amendment of the committee is to insert the following:

"2d. For the erection of a harbor light on a point of land lying west of the entrance of Buck's harbor, in Brooksville, $3,500.

"3d. For the erection of beacons, buoys, and spindles between Owl's Head and White Head light-houses, and through Muscle Ridge channel, $4,000.

"4th. For the erection of four buoys at Goldsborough, at the following places: one on the northeast point of Calf island, one on the western point of the middle ground off Stone island, one on Half-tide ledge, and one on a sunken rock at the entrance of Flanders bay, $200."

The amendments were agreed to.
Mr. Hamlin. The next amendments of the committee are to insert the following:

"For six hollow iron buoys for the waters of Cape Fear, $1,320.
"For one buoy in New Inlet, Great Egg Harbor, and three in Hart-foard, $200.
"For a bell, to be placed on one of the light-boats in Chesapeake bay, to be designated by the Secretary of the Treasury, $200.
"For the erection of a light-house at Santa Cruz, California, $30,000.
"For the completion of light-houses in California and Oregon, $120,000.
"For life-boats and other means for rendering assistance to wrecked mariners and others on the coasts of the United States, to be expended under the control and direction of the Secretary of the Treasury, $10,000.

"For testing the apparatus of Wilson & Meacham for illuminating light-houses, $1,000, to be expended under the direction of the Secretary of the Treasury."

The amendments were agreed to.

Mr. Hamlin. The next amendment is to strike out of the following section the words "under the fifth section of this act," and also the word "not:"

"Sec. 7. And be it further enacted, That all such reports shall, as speedily as may be, be laid before the Secretary of the Treasury, and if such as to authorize the work without further legislation, he shall forthwith proceed with it, otherwise such reports shall be laid before Congress at the next ensuing session; but in all cases where the person designated by the Secretary of the Treasury under the fifth section of this act, does not report such preliminary examination as expedient, the provisions of this act shall, without delay, be carried into execution."

The amendment was agreed to.

Mr. Hamlin. The next amendment is to insert the following in the bill:

"For constructing three small or harbor light-houses in Galveston bay, to wit: one at Red Fish bar, one at Clopper's bar, and one at Half-moon shoal, $5,000, in addition to the $200,000 already appropriated for the light-house on Red Fish bar."

The amendment was agreed to.

Mr. Hamlin. The next is to insert:

"For the removal of the light-house at Milwaukee, and rebuilding the same at or on the north point of Milwaukee bay, $5,000."

The amendment was agreed to.

Mr. Hamlin. The next amendment to the bill is to strike out sections five and six:

"Sec. 5. And be it further enacted, That if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house or light-boat, beacon or buoy, or to
ascertain more fully what the public exigency demands, the Secretary of the Treasury shall thereupon direct the superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes.

SEC. 6. And be it further enacted, That the officers so directed shall forthwith enter upon the discharge of the duty, and after fully ascertaining the facts shall report, first, whether the proposed facility to navigation is the most suitable for the exigency which exists; and, second, where it should be placed, if the interests of commerce demand it; third, if the thing proposed be not the most suitable, whether it is expedient to make any other kind of improvement; fourth, whether the proposed light has any connection with other lights, and if so, whether it cannot be so located as to subserve both the general and the local wants of trade and navigation; and, fifth, whether there be any, and if any, what other facts of importance touching the subject;” and insert in lieu thereof the following:

“SEC. —. And be it further enacted, That the Secretary of the Treasury shall cause a preliminary examination to be made of the site or location of each new light-house and light-boat herein provided for; and if upon such examination and report thereon he shall be of the opinion that the work is inexpedient, then said work shall be suspended until Congress shall otherwise order.”

Mr. WELLER. I think the sections proposed to be stricken out are better than the one to be inserted, and I hope, therefore, the amendment will not be agreed to. It seems to me that there is a propriety in having the information contemplated by those sections.

Mr. Cass. I think there is no doubt that this whole system of light-houses has outgrown itself. I suppose that every Senator is aware that there are many light-houses in places where they are not wanted. They are too numerous. Too much legislation has been made without a proper knowledge of facts. Gentlemen have got up here, and, when a bill was being put hastily through, inserted appropriations for light-houses where they were not necessary.

Mr. WELLER. There are appropriations in this bill for removing light-houses.

Mr. Cass. I know it. It strikes me, therefore, that we are beginning at the wrong end when we make appropriations first, and then authorize an inquiry to ascertain whether they are proper. There is a defect, it seems to me, in the whole system. We want a radical change in it. It is proper to have the Fifth Auditor of the Treasury to check the accounts; but you want, beforehand, competent, scientific men to whom all questions concerning the location, &c., of light-houses should be committed. You would then have a just and economical system, but you have a most profuse one now.

Mr. WELLER. That is my idea exactly.

Mr. HAMLIN. I do not think it of much importance whether the sections are stricken out and the one which has been reported adopted in their place or not.

Mr. WELLER. Then, withdraw the amendment.
Mr. Hamlin. No, sir, I shall not withdraw it, because I think it will improve the bill. It is more direct; it is more certain. The sections proposed to be stricken out are complicated, referring the matter to the Coast Survey and Light-house Board, making it the common duty of both, while the one which the committee propose to insert makes it the simple duty of the Secretary of the Treasury to act in such a way as he thinks just and proper. The next amendment which I have to offer is a material one, and will meet with the views of the Senator from Michigan; it is to strike out all after the seventh section which refers to the organization of a Light-house Board. When that comes up I shall briefly state my views upon it.

The amendment was not agreed to—ayes 11, noes not counted.

Mr. Hamlin. The next amendment is to strike out all after the seventh section of the bill, as follows:

"Sec. 8. And be it further enacted, That the President be, and he is hereby, authorized and required to appoint, immediately after the passage of this act, two officers of the Navy of high rank, one officer of the corps of engineers of the Army, one officer of the corps of topographical engineers of the Army, and two civilians of high scientific attainments, whose services may be at the disposal of the President, and an officer of the Navy, and an officer of engineers of the Army, as secretaries, who shall constitute the Light-house Board of the United States, and shall have power to adopt such rules and regulations for the government of their meetings as they may judge expedient; and the board so constituted shall be attached to the office of the Secretary of the Treasury, and under his superintendence shall discharge all the administrative duties of said office relating to the construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, sea-marks, and their appendages, and embracing the security of foundations of works already existing, procuring illuminating and other apparatus, supplies and materials of all kinds for building and for rebuilding when necessary, and keeping in good repair the light-houses, light-vessels, beacons, and buoys of the United States.

"Sec. 9. And be it further enacted, That the Secretary of the Treasury shall be ex officio president of the Light-house Board of the United States; and the said board, at their first meeting, shall proceed to ballot for one of their members as chairman, and the member who shall receive the majority of ballots of the whole board shall be declared by the president to be chairman of the Light-house Board, who shall, in the absence of the president of the board, preside over their meetings, and do and perform such acts as may be required by the rules of the board.

"Sec. 10 And be it further enacted, That the Light-house Board shall meet four times in each year for the transaction of general and special business, each meeting to commence on the first Monday in March, June, September, and December; and that the Secretary of the Treasury is hereby authorized to convene the Light-house Board whenever in his judgment the exigencies of the service may require it.

"Sec. 11. And be it further enacted, That the Secretary of the Treasury be, and he is hereby required to cause such clerks as are now employed on light-house duties in the Treasury Department, to be trans-
ferred to the Light-house Board without any change of salaries, and to provide the necessary accommodations for the secretaries and clerks, for the preservation of the archives, models, drawings, &c., and for holding the meetings of the board; and that he cause to be transferred to the proper officers of the Light-house Board all the archives, books, documents, drawings, models, returns, apparatus, &c., belonging to the light-house establishment of the United States.

"Sec. 12. And be it further enacted, That it shall be the duty of the Light-house Board, immediately after being organized, to arrange the Atlantic, Gulf, Pacific, and Lake coasts of the United States into light-house districts, not exceeding twelve in number; and the President is hereby authorized and required to direct that an officer of the Army or Navy be assigned to each district as a light-house inspector, subject to and under the orders of the Light-house Board, who shall receive for such service the same pay and emoluments that he would be entitled to by law for the performance of duty in the regular line of his profession, and no other, except the legal allowance per mile when travelling under orders connected with his duties.

"Sec. 13. And be it further enacted, That the said Light-house Board, by and with the consent and approbation of the Secretary of the Treasury, be authorized and required to cause to be prepared and distributed among the light-keepers, inspectors, and others, employed in the light-house establishment, such rules, regulations, and instructions, as shall be necessary for securing an efficient, uniform, and economical system of administering the light-house establishment of the United States, and to secure responsibility from them; which rules, regulations, and instructions, when approved, shall be respected and obeyed until altered and annulled by the same authority.

"Sec. 14. And be it further enacted, That it shall be the duty of the Light-house Board to cause to be prepared by the engineer secretary of the board, or by such officer or engineer of the Army as may be detailed for that service, all plans, drawings, specifications, and estimates of cost of all illuminating and other apparatus, and of construction and repair of towers, buildings, &c., connected with the light-house establishment; and no bid or contract shall be accepted or entered into, except upon the decision of the board at a regular or special meeting, and through their properly authorized officer.

"Sec. 15. And be it further enacted, That hereafter all materials for the construction and repair of light-houses, light-vessels, beacons, buoys, &c., shall be procured by public contracts, under such regulations as the board may from time to time adopt, subject to the approval of the Secretary of the Treasury; and all works of construction, renovation, and repair shall be made by the orders of the board, under the immediate superintendence of their engineer secretary, or such engineer of the Army as may be detailed for that purpose.

"Sec. 16. And be it further enacted, That it shall be the duty of the Light-house Board to furnish, upon the requisition of the Secretary of the Treasury, all the estimates of expense which the several branches of the light-house service may require, and such other information as may be required, to be laid before Congress at the commencement of each session.
"Sec. 17. And be it further enacted, That all acts and parts of acts inconsistent with the provisions of this act are hereby repealed, and all acts and parts of acts relating to the light-house establishment of the United States not inconsistent with the provisions of this act, and necessary to enable the Light-house Board, under the superintendency of the Secretary of the Treasury, to perform all duties relating to the management, construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, sea-marks, and their accessories, including the procuring and testing of apparatus, supplies, and materials of all kinds, for illuminating, building, and rebuilding, when necessary, maintaining and keeping in good repair the light-houses, light-vessels, beacons, buoys, and sea-marks of the United States; and the second and third sections of the act making appropriations for light-houses, light-vessels, buoys, &c., approved March 3, 1851, are hereby declared to be in full force, and shall have the same effect as though this act had not passed: Provided, That no additional salary shall be allowed to any civil, military, or naval officer who shall be employed on the light-house board, or who may be in any manner attached to the light-house service of the United States under this act: And provided further, That it shall not be lawful for any member of the Light-house Board, inspector, light-keeper, or other person in any manner connected with the light-house service, to be engaged, either directly or indirectly, in any contract for labor, materials, or supplies for the light-house service, nor to possess, either as principal or agent, any pecuniary interests in any patents, plan, or mode of construction or illumination, or in any article of supply for the light-house service of the United States."

It will be seen, by reading the provisions contained in that bill, which it is proposed to strike out, that they contain the frame-work of the Light-house Board. I concur most fully in what fell from the Senator from Michigan a few moments since, that our present light-house system has outgrown the present organization. I believe I express the unanimous opinion of the Committee on Commerce, when I say that they concur with me in that opinion; and I believe I also express the opinion of the committee as unanimous, when I say that they deem it unadvisable now to take a plan which has been reported as yet by no committee—a system that will make it as expensive as the English system in a very few years, and which, if adopted now, must be adopted here without investigation, without discussion, and without that preliminary examination which is necessary for such a subject. It is the purpose of the Committee on Commerce to let these sections be stricken out, and at another session of Congress to report a bill more in detail, which shall remove some of the objections which, in their opinion, exist to these sections, and which they would have done at this late hour, if it could have received that attention before the Senate which they believe it merits. For these reasons, it was believed by your committee that it was better to strike out these sections, rather than prematurely adopt such a system. I do not propose to discuss the question now. I do not propose to go into the details of it; but I ask the Senate carefully to consider whether it is not better to postpone this matter until it can receive the sanction of its own committee? I ask the Senate if it is not better, if it is not more proper, that our legislation
should be marked by such a course, than be guided by the outside pressure of Army and Navy officers; for I see them all around me now. I am for a board, but I am not for one that is to be controlled altogether by Army and Navy officers. I am for incorporating in it as many scientific officers as are necessary; but I am not for a system that shall be built up and placed solely under their control. I will, at the proper time, aid most cheerfully and fully in perfecting a board which shall meet the approval of Senators.

Mr. Cass. As to the external pressure here, I have only to say that I have not talked with an Army or Navy officer on this subject on the floor of the Senate. There is a good deal of reason in what the Senator says. I think the present system is wrong. I know there ought to be a change. I know the system has outgrown the present means of controlling it. But if the honorable chairman of the Committee on Commerce and the committee are disposed at the next session to take up the subject, and give us a proper system, I am disposed to submit to that.

Mr. Weller. We would better begin now.

Mr. Davis. If nobody else brings forward at the next session a bill to remedy the system, I shall. I pledge myself to do it. I agree with the Senator from Maine entirely.

Mr. Hamlin. I pledge myself that I will take up the subject and present a bill, and concur with the Senator most cordially in perfecting the system.

Mr. Cass. I wish to remark that, so far as respects the board, I would not put two civilians upon it. I do not think it necessary. We would better go to the officers of the Army and Navy, who are already paid, and take the members of the board from them.

Mr. Davis. I have bestowed some attention upon this subject. Some years ago I made a report to the Senate, in which I threw out the idea that a system could be adopted, simple in its character, inexpensive, and yet efficient. I think so still; but as the Senator from Maine observes, although the subject has been in the hands of two committees—one in the House and one in the Senate—and although the Light-house Board, appointed under the act of last session, has written a book of some seven hundred or eight hundred pages upon it, neither of these committees is prepared to report upon the subject. The sections which we propose to strike out were inserted in the bill by the House of Representatives on the motion of some gentleman who had given his attention to the subject. I think we would better wait and mature a bill which may be something like a matured measure, economical, just, and efficient in its character; and for that further time is necessary.

Mr. Pearce. The next session is a session of three months' duration. I understand that this bill was drawn up by the Light-house Board, and laid before the Committee on Commerce three months ago. Upon that committee is the Senator from Massachusetts, [Mr. Davis,] who, as he has said, paid attention to the subject many years ago—I think as far back as fourteen years. That Senator made a report upon this subject, in which he shows very satisfactorily the inefficiency of the present system. The
Light-house Board, which was constituted at the last session of Congress, have examined the subject most thoroughly, and have made a report to us. No one can read that report, or even a portion of it, without coming to the conclusion that our present system, if system it can be called, is a wretched one. There has never been any practical organization here. The system has never availed itself of any of the improvements that have been adopted in other countries. If improvements have been adopted, they have been forced upon it by legislative action, as when, by an act of Congress, we compelled the adoption of the lens lights in some of our northern light-houses. It is admitted not only by the Light-house Board, but by the report of the Senator made years ago, by the late Secretary of the Treasury, and by gentlemen admirably qualified to determine upon the subject—such as Professor Pierce, of Harvard—that our system does not secure efficiency in the lights; that it does not compare favorably with the light-house systems of other countries; and does not supply the requirements of navigation and commerce, and the wants of humanity.

The light-houses themselves are not constructed properly. I see it stated that some of the best light-houses in the United States are those which were constructed by the British government before the revolution. The light-house at Sandy Hook, for instance, was built by the British in 1762, and is now standing a permanent structure; while light-houses which have been built under the present system, since 1838, have fallen down. The board reports that they were deficient in construction, and I see, in the defence of the present Fifth Auditor, what is enough to satisfy me that the bricks and mortar are not put together in a way which a man of common sense would know to be necessary for them. Then the lights used are not improved. They are not those which secure the greatest use of the light which may be derived from the consumption of so much oil. They have adopted in England, France, Russia, and Sweden, and other places, the lens system, the advantage of which is this: In a common light twenty-nine thirtieths of the light is lost by its going up into the atmosphere or striking down to the earth; only one-thirtieth striking the horizon to meet the eye of the navigator. That is the loss of light unaided. The lights aided by reflectors lose only twenty-five thirtieths. That is an improvement of four-thirtieths by the adoption of the reflector system. Under the lens system—the refracting system—the dioptric system—the light loses but five-thirtieths. It has a much greater intensity, therefore, than the light in the other cases. The superiority of the lens system over the reflector is exactly as much as of the reflector system over the unaided light. That is an important consideration. It is important in order to get a sufficient amount of light with economy. In these reflectors you have so many lamps, and so many reflectors, to give the same available light with one lamp and a lens; and in this way you increase the consumption of the oil. I see that this report of the Light-house Board gives the summing up of the whole affair in regard to our system, a part of which I will read, instead of giving it in my own language. They say:

"That the towers and buildings have not been constructed, in general,
of the best materials, nor under the care and supervision of competent or faithful engineers.

"That the want of professional knowledge of the materials, mortars, cements, &c., for the construction and repairs, or faithfulness on the part of those charged with the duty, was apparent in nearly all the modern towers and buildings visited by the board.

"That the present large sums annually required for renewing, renovating, and repairing towers and buildings, are the consequence of the want of an efficient organization, which could afford the necessary professional ability for plans, drawings, and superintending of constructions and repairs.

"That the towers are deficient in the necessary proper accommodations for oil and other supplies; in the mode of fitting them up, and in the materials employed for the interior work; and the buildings ill adapted to the comfortable accommodation of the keepers.

"That the lanterns are, as a general rule, of improper dimensions, constructed of ill-adapted, and, in the end, not economical; materials, without professional or scientific skill; and, in many instances, not suited to the use for which they are designed.

"That there is no proper system of ventilation for lanterns.

"That the means said to be employed for ventilating are wholly inadequate, and contrary to true scientific principles.

"That there is very little attention paid to the painting of the interior of the lanterns and astragals, and in glazing.

"That, under a well-organized system, the lights, and other aids to navigation, might be greatly increased in number and efficiency, at a large saving upon the present annual cost.

"That there has never been an efficient systematic plan of construction, illumination, inspection, and superintendence of lights, &c., in the United States."

We know well how the superintending of these light-houses is carried on. The collectors of the customs have charge of them. They get some two and a half per cent. upon their disbursements, amounting to about four hundred dollars per annum, not exceeding that by law. These collectors are not selected with reference to their capacity to judge of the lights. They may be exceedingly efficient men as collectors, and yet very inefficient as regards the duty of superintending the lights. Their inspection amounts to little or nothing in point of fact. I know that occasionally they go down the bay on a fishing party, and take a glance at the light, ask a few questions of the keepers, and then do no more. They make no improvement in the lights. Nobody ever heard of their improving them. You must then have proper persons—persons capable of instructing the light-keepers as to their duties, and seeing that they perform their duties satisfactorily—persons who, in fact, understand the whole system, from the construction of the edifice down to the scientific principles which regulate the construction of the lights and burners.

But this Light-house Board, in their report, state further, that the lights are not well distributed, or properly and sufficiently well distin-
guished along the coast. I think in one place they are called a nuisance, because they interfere with each other, and confuse mariners who are not thoroughly acquainted with the United States—foreign navigators, or those of our own country who are not familiar with them. That comes from this circumstance: The system is not provided with means of distinguishing the lights one from another; and by-the-by that is another advantage in the system which prevails in France and elsewhere. Again: the Light-house Board say:

"That many of the small lights have an unnecessary number of lamps and reflectors, while sea-coast lights are greatly deficient in them."

They say further:

"That the buoys in the harbors of the United States are defective in size and shape, and deficient as a general rule; and that sufficient care is not taken, nor competent persons employed to place, moor, and replace them."

They say further:

"That the light-vessels are, in general, not adapted to the service they are required to perform, being defective in size, model, and moorings."

They are not properly moored, and are, consequently, often carried away. We hardly ever hear of such a thing as a light-boat being carried away in England. Here they are carried away, and not replaced for a long time, and, in the meantime, comes the mariner in the midst of a storm, and his vessel is lost for want of a proper and efficient organization of the system.

I will not detain the Senate by going over all the items to which this report alludes; but if the Senate had patience to listen, I could refer to the testimony of such men as Sir David Brewster, to show how infinitely the system we desire to establish is superior to the present one. So the report of the Senator from Massachusetts, himself, to which I have alluded, and which is full of practical information on the subject, is the best answer to the proposition which he now makes, to let this subject go over until the next session. It is fourteen years since the subject was agitated, and we have not advanced an inch, unless it be as to the lens lights at Sankaty Head and the Navesink.

Mr. Davis. The Senator is greatly mistaken.

Mr. Pearce. At all events, we have not advanced in the establishment of that system of lights. I presume I am not mistaken in that. I say we have established three of these improved lights, and three only.

How many light-houses have we? Something over two hundred and twenty.

Mr. Davis. Nearly three hundred.

Mr. Pearce. Nearly three hundred, and we have adopted only three of the improved lights. Then in regard to the cost, I understand that a lens of the first class burns about five hundred and seventy gallons of oil in a year, and an equivalent light with the reflectors burns perhaps between double and triple that amount. So the second order of lens burns three hundred and eighty gallons, and an equivalent reflector burns a thousand gallons of oil. Here is what Sir David Brewster says in speaking of these lenses:

"If these twenty-four reflectors are arranged in groups of six, then
the brightest light which at any one time reaches the eye is that of six reflectors, which is repeated four times in each revolution; whereas in the lens apparatus we have a light equal to nine reflectors repeated eight times during each revolution, besides the additional light of the eight smaller lenses, and that of the other piece of apparatus. Hence it was demonstrable that the lens apparatus is not only £413, or eventually £513, cheaper than the reflector apparatus, but gives a more intense and penetrating light."

I think, therefore, it will be admitted, without reading further extracts to the Senate, that an improvement is desirable in our light-house system, and that this is not likely to be effected under its present light-house administration, which is admitted on all hands to be defective. This bill is not going to increase the expense greatly. It is not proposed to give any additional pay to the officers who serve on the board. It is not proposed to give any pay at all to the civilians. I believe it is known that competent civilians can be obtained to serve without charge. Then the expense of the inspectors of the present lights—there are some forty collectors who, I believe, act as inspectors of the lights; if they get $400 a piece, that is $16,000 expended in that way—will much more than pay all the expenses of the proposed board, because we have Army and Navy officers who will receive no increased pay for their duties on the board, and the civilians will receive no pay. I suppose, of course, the travelling expenses will be allowed, but they will be at the rate which they get in the regular service. I suppose there will be no increased expenditures. I hope, therefore, the proposition to strike out these sections will not be agreed to.

Mr. Toucey. It is to be regretted that important measures cannot be brought before Congress until the close of the session, and that we are compelled, therefore, to embrace the occasion to adopt such reforms and improvements as the exigencies of the public service demand. I think there is but one opinion, that our present system is behind the age; that it needs reform; that it needs to be brought up to the standard of modern improvements and discoveries. I am entirely in favor of the plan of introducing a board composed of competent, skilful, and learned men upon this subject, and of revising the system, which has fallen so much behind the times. I am not disposed to go into the details of the system now. Although no Senate committee or committee of the House may have been ready to report upon the subject, yet the House has reported and has presented us a bill. That bill presents to us an important public measure—one which commends itself to my judgment and to my support. I therefore shall vote to retain these sections in the bill and concur with the House of Representatives, so that the system which they propose may be adopted; and at the next session, if any defects should be found in its details, or any errors in the form which it may assume, I shall be under an obligation, as a member of this body, to the Committee on Commerce if they will bring forward such amendments as may be necessary. In the meantime, however, I propose to take the measure as it is.

Mr. Davis. I appeal to the honorable Senator from Connecticut whether any such pressing emergency has sprung up in the system under which we have lived for half a century as to make it necessary to adopt
a complicated bill without considering the subject at all. That is the
effect of this step. What fell from my learned friend from Maryland
[Mr. Pearce] shows how complicated the subject is; how many grave
considerations are involved in it, and how necessary it is to examine it
before it can be understood. I think the Senator from Maryland is mis-
taken in several particulars. He says that we ought to adopt the len-
ticular system more extensively than we do. He contends that it is
economy to have the lenses; and he proves that, by showing that the
amount of oil consumed in the lenticular lamp is less than the amount
consumed in the reflector in a light-house, where all the horizon is required
to be lighted. That is true; but then see how readily the reflector
accommodates itself to our system. When the Light-house Board made
these comparisons they assumed that the whole horizon is to be lighted.
The lenticular lamp can light no less than the whole horizon. It cannot
be diminished. The whole quantity of oil must be used, whatever is the
amount of light wanted, while, on the other hand, as every reflector has
its own lamp, every reflector you take from the light diminishes by so
much the expense. The board dwelt upon a comparison which does not
apply to the general system of lights, for this reason: In a very large
portion of the lights upon the coast of the United States it is neces-
sary to light but one-half of the horizon; therefore these comparative
expenditures do not come justly into the consideration of this business
at all, unless you found it upon the actual state of things.

But the Senator says our system is deficient—that it is feeble and ob-
jectionable. I know what sort of sweeping declarations are put down
in the book which he holds up as authority; and I must be permitted to
say to the Senate that, after reading it with some attention and care, I
cannot find one thing in the present system which that Light-house Board
approves of; and yet the Senate well knows that we have had that
system for a long time, that we have gone on comfortably under it, and
that our commercial community and ship-owners are content with it;
although, at the same time, I admit that it may be improved, but it will
have to be improved at an expense. The idea of economy is preposter-
ous, upon the supposition which is made by those who introduced these
sections into the bill. We build a light-house, and we put reflectors in
it for some $3,000 or $4,000. That is the common grant made to set
up a light-house and light it. Now, you cannot purchase a set of lenses
for less than about $6,000; and has it ever occurred to the Senate that
there is not a manufactory of these lenses on earth, except those which
are set up by the French government? And are we to be dependent
on the French government for every light we burn? Is that a sound or
just view of the subject? I admit the great importance of the lenses;
I admit their great power; and I would heartily go with my friend, or
any other gentleman, to establish lenses of the first order upon the great
points which project out into the sea, where vessels first make the land.
Those great leading points ought to have the best lights, regardless of
expense; but when you go into questions of expenditure, it must be ad-
mitted that it takes a much greater portion of labor to superintend and
take care of the lenses than it does in the case of common reflectors.
I see that this very board censure the Fifth Auditor for having an un-
necessary number of men superintending the lenticular lights at the Navesink, New Jersey. Now, I happen to know personally that the Frenchman who was sent over by the manufacturers to set up those lights, put in, to take charge of them, just the number of men he was directed to put there by those who constructed the lights. It is a notorious fact, that it takes a greater number of men to take charge of these lights than of the reflectors, and I could very easily show you reasons for it if time permitted.

But, without entering into this subject, I think enough has been developed to show that this is a complicated system; that it should be provided for by law with great care, and should be introduced with caution and proper provisions in regard to economy; for you cannot change the lights of the United States into lenticular ones short of an expense of millions of dollars. You would have to alter every lantern. The reflector lanterns are not adapted for lenses. They are not high enough. They are not adapted to the introduction of the machinery necessary for the lenses. The Committee on Commerce, in my judgment, behaved very wisely when they proposed to postpone this system and go on under the system which has been in operation for years, until we can mature a plan, and do it with prudence, precaution, and economy; for you will find any light-house system expensive enough. Let it take what form it may, it will soon increase to double its present expense. You have now near three hundred light-houses. Soon the number will increase to six hundred, and you will find the system burdensome enough at any rate of economy.

I will add one word more. One of the most sagacious men that I know of, and with whom I am acquainted—Mr. Stevenson—who has charge of what is called the Scotch light, has investigated this subject more thoroughly than any other individual living. I see that, in the last book published by him, he gives the preference to the reflector lights in certain positions. Where certain unvarying lights are necessary, as in narrow channels, he says the reflector light has the preference. It is true the lenses give greater light. They throw out more rays, but they are not as well adapted to some stations.

Then it follows that we should have at the head of the system an able and efficient man. One head is better than ten; and an able and efficient man who understands the subject from top to bottom will be able to go into it, and from his knowledge to regulate it according to economy, and according to the position in which the lights should be placed. He should be a man capable to discharge his duties, and he should have a suitable organization under him. But I must say, however respectable these boards are, I never have thought them worth anything. You had a Navy board, but were obliged to give it up. You had a Census board, but it did nothing. You had a board connected with the Patent Office, but who ever heard of its doing anything? I never did. These boards only serve as a shelter to cover some one person who does the business allotted to them. Then, I do not see any propriety in limiting such a board as is here proposed to the officers of the Army and Navy. You should take talent wherever you find it. But I do not think this
is the time to discuss the subject. I think it would better be postponed until the next session.

Mr. Pearce. I understand the Senator to say that the cost of a lens light is $6,000. I suppose that is the first class. But I see a statement in this report on the subject.

Mr. Davis. The least cost of those lights which have been brought here is $10,000.

Mr. Pearce. I see in this report a comparison of the cost of the lights required to light the harbor of Baltimore:

"It may be useful to compare a few of the smaller lights, and as an example, the Lazaretto light, near Baltimore, may be taken. There are eleven lamps and spherical reflectors in this tower.

"Reported consumption last year, 431 gallons of oil.

"Estimated consumption, according to European standard, 440 gallons.

"United States estimate, 385 gallons.

"This light is required to light a harbor and the entrance to it, of small extent, a visibility not exceeding five to six miles.

"The first cost of the eleven lamps and reflectors, (which require to be renewed frequently,) frame, fitting, &c., independently of spare lamps, burners, &c., will be not less than $350.

Annual expense for oil, 431 gallons, at $1 30 per gallon........ $560 00
For chimneys, glasses, and wicks---------------------------------- 12 30

Extra burners, supposed not less than.............................. 5 00

Annual cost............................................................. 577 30
Independent of cleaning, powders, rags, &c., not required for a lens light.

"The first cost of a sixth-order lens apparatus, which does not require to be renewed, with three lamps, (two being extra,) and pedestal, &c., complete, estimating five francs to a dollar, will be $252, which is less than the first cost of the reflector light by $98.

"The consumption of oil per annum for the lens light will be
48 gallons, costing--------------------------------------------- $62 40
For wicks and chimneys, say----------------------------------- 1 50

$63 90"

Besides, it is to be remembered that the lenses are imperishable; much less liable to injury than the reflectors; so that the first expense need not be repeated.

Mr. Davis. This comparison does not give a just view of the subject. It may answer for that little bug-light. The whole of it may be true; but it does not touch the whole subject at all.

Mr. Pearce. I mentioned that to show that while the Senator desires to begin the improvement of lights on the sea-coast. it is desirable to have them upon points where it is not necessary to have the lights ex-
tended such a distance as to the entrance of the harbors. Then, as to the organization of the system. I find in the report made by the honorable Senator himself in 1838, some account of the French system. He says:

"The general supervision of the light-houses, &c., devolves on the Minister of the Interior, but no new light can be established without the concurrent opinion of this minister and the Minister of Marine.

"Subordinate is a Commission des Phares; the members of which, except the secretary, receive no compensation. It has hitherto consisted of certain civil engineers; employed in the administration of roads and bridges, naval officers, and astronomers, with the late distinguished M. Fresnel, as secretary and chief engineer. The design of such a combination is manifestly to bring to the public service the requisite qualifications to select the best sites, to construct the most suitable buildings, and to bring into use the most perfect and scientific apparatus."

Mr. Davis. The Senator will not understand me as recommending that system.

Mr. Pearce. The Senator introduced it into his report without commenting upon it. Then again, Mr. President, it does not follow if we establish this board that it is to go to work at once and dismantle all the light-houses, and saddle upon us the expenditure of lens lights on all the places on the coast. I take it that it is to be a board composed of competent men, who will proceed cautiously, much more cautiously than the present light-house administration does. I presume that they will have reference to the revenue of the country in the improvements which they make in the system from time to time, and thus they may be able gradually to correct the evils of the present system. But I will not detain the Senate further.

Mr. Pratt. I desire to say a word in answer to the argument in reference to the propriety of postponing this subject until the next session of Congress. That proceeds upon the hypothesis, as my colleague has just said, that the board which you are about to appoint is to set to work at once and do everything wrong. It cannot be maintained unless upon the hypothesis that the board are not only to proceed to dismantle all the existing light-houses, but to proceed upon an entirely erroneous plan in organizing the new ones. If we adopt this plan now, it is manifest to every one that we shall have the ability of the distinguished Senator from Massachusetts, at the next session of Congress, for the purpose of maturing, altering, and amending it, if it should be necessary. It is admitted that the present system is entirely wrong. We would better, then, make the commencement of a new one, by appointing a scientific board for the purpose of examining and commencing another system. If it be found, as it is found in almost every system, necessary to amend it, we shall then have time to do so. The sections proposed to be stricken out of the bill were prepared by one of my colleagues in the other House, [Mr. Evans,] a gentleman of considerable scientific attainments—a gentleman who has devoted many years of his life to the investigation of this subject; and upon whose judgment, as much confidence as I have in my friends from Massachusetts and Maine, I for one am
willing to rely, until experience shows that there is some fault in the system which has passed the House.

The Senator from Massachusetts says that the lights used in the French system are much more expensive, and that they are unnecessary, except at some points going out into the sea. His argument, on that account, against the propriety of establishing the board, if it amounts to anything, must go further. He must suppose that that scientific board will do what he says is unnecessary, and put these expensive lights where they are not important to be put. He asks, are we willing to adopt this French system of lights when there is not a single manufactory of the lenses in this country? Now, I apprehend that, if it be necessary to adopt that system, the effect of it will be to establish such a manufactory in our own country, and not to leave us dependent upon the French; for any one thing that has been manufactured by the ingenuity of man is unknown where the Americans have not been able to compete with the rest of the world, when it became necessary. So far from being dependent upon France, if we adopt the system, we shall have manufactories of the article here in a few years surpassing those which are in France. I can see no possible reason for the postponement of the subject; and I was sorry to hear my friend from Michigan [Mr. Cass] giving in to it, after he had asserted that the system under which we are now acting is wrong.

Mr. Davis. If the Senate wants a little foretaste of what these boards do, I will refer to the light-house expenses under the English system. I hold in my hand an official letter, addressed to the British government by our minister at London, in 1850, on this subject. He states that "the American mail steamers entering at Liverpool pay for light dues the sum of £62 for each voyage." That is, every time when one of our mail steamers enters the port of Liverpool she pays $300 in light dues; and all our shipping pays in that proportion. In the last ten years the English light-house board, to support their system, have collected from our commerce upwards of $1,100,000. I hold the evidence of it in my hand.

Mr. Brodhead. How do you propose to remedy it?

Mr. Davis. I do not propose to remedy that; I only state these facts to show that the system is enormously expensive; that it is vastly more expensive than ours; and yet gentlemen wish us to imitate France and England, and to follow the system carried on through their instrumentality, instead of following the simple customs and usages which belong to our Government. They propose to complicate our system with these boards, after the fashion of the middle ages. I say that your experience with boards tells you that they are inefficient and unnecessary. You want an efficient and responsible head of the system, and nothing else, to carry on your business. We have no time now, I repeat, to organize this system properly. It cannot be done judiciously, and with a proper reference to economy. Where improvements are necessary, I am for them. I am from a commercial part of the country, and I want as good lights as anybody. There is not a portion of the country that has more ships or more tonnage afloat, in proportion to their population and wealth, than the State of Massachusetts. I am, therefore, the last
man to stand in the way of any improvements; but I wish to act deliberately upon this subject, and in such a way that I can vindicate my conduct.

Mr. Mallory. The State which I represent, has fifteen hundred miles of sea-coast, and a dangerous navigation. We have strongly felt for twenty years the want of a proper system of lighting our coast. It is one of the most important subjects that can come before Congress. Its importance has been somewhat exemplified by the extraordinary volume which has been published by the board of examiners—extraordinary in size, I mean. I have not had time to examine it since it has been submitted to Congress; but the very fact that the board of examiners have found it expedient, in order to show the importance of the subject, to publish a volume of that size, proves that we should not hastily adopt legislation of this kind without investigating what they have written. I have had some practical knowledge of light-houses. I have had the control and charge of them. I have procured their oil and appointed their keepers, and have made a practical examination of them for years, and therefore know something of the importance of the subject; and I am free to say, if the Fresnel lamp is to be adopted generally in our light-houses, the expense of lighting our coast will be increased in the next ten years to $3,000,000. I will give an example of the expense of this kind of lights. One of the best light-houses on the coast of America—the light-house at the Tortugas, on the coast of Florida—has been refitted with the first class twenty-one-inch lens, with thirty-one-inch glass. Its light can be seen as far as the curvature of the earth will permit. By a sloop-of-war, it can be seen from the fore-yard twenty-two miles. It is pronounced to be one of the best lights in the world. That light cost about $10,000. A similar apparatus has been put up by the topographical corps at the screw-pile light on Carysfort reef. We have the report of a topographical officer upon that light, and he pronounced it to be one of the best lights in the country. It can be seen as far as the curvature of the earth will permit. I know from an actual inspection of the lights on that coast, that, as they are now constructed, they are like great bonfires upon the ocean as far as they can be seen.

Undoubtedly there are points where the Fresnel lamp is absolutely necessary, where we must not count the cost in establishing it. The light at the Dry Tortugas is one of this class. The Fresnel light itself at Carysfort reef cost by contract in France $10,000 without the structure on which it is placed. We have appropriated $100,000 for erecting it. We appropriated $60,000 a few days ago, and $40,000 have already been expended, making the cost of the tower alone about $100,000. But the cost of the light-houses where they are necessary should not enter into controversy. The money must be expended if they are essential.

I am free to admit that this matter of lighting the coast needs examination and systematizing. But, sir, I can tell you, whatever evidence may be in that book, that there must be other evidence on the subject now in the office of the Fifth Auditor of the Treasury. There must be registers kept there of the opinions of the first shipmasters in the coun-
try, which are filed in the custom-houses, showing their opinion of our lights. I have examined some of them. It is a common thing to hear even American shipmasters classify our first-class lights with the first-class lights of England and France. There is no comparison in regard to economy. Ours is the most economical system on earth. Not only is it more economical than that of France, but it is much more so than that of England. When a Fresnel light is established, it requires two keepers. They must be mechanics, who understand the machinery of the lights and its working; and you cannot get them for a small salary. They will not serve for $500 a year, because they can get more elsewhere. The first cost of the lighting by this system will be immense. I grant it is the best system in the end, but in the beginning it is very expensive.

Mr. DAVIS. Will the Senator allow me to make a suggestion? Since the introduction of the reflectors at Boston, reflectors have been exceedingly well made in this country—as well as in any other—and more economically.

Mr. MALLORY. Yes, sir; we have the best reflectors which are used, and the parabolic reflector of twenty-one inches will show you the light as far as the curvature of the earth will permit. There is no urgent necessity for adopting the system proposed by the House. There is no urgent necessity for the board; and it seems to me to be exceedingly strange, when such is the case, that we are called upon, without any examination of the report; without having an opportunity to examine it, hastily to adopt a board of this kind. We can make improvements without establishing such a board. We are in the habit of specially legislating for light-houses. We legislated specially for the light-houses on Minot's ledge and Carysfort reef; we directed that they should be constructed by the topographical corps. We frequently take particular light-houses out of the general system. There is consequently no such urgency in the matter as to require the adoption of the board, when no committee has reported in favor of it; when no Senator has had an opportunity to examine the evidence, and when the chairman of the Committee on Commerce pledges himself, within the next three months, to systematize and bring forward a plan for the better regulation of light-houses.

Mr. WELLER. As a representative of one of the States of this confederacy deeply interested, as a matter of course, in the establishment of proper light-houses, I desire to say a few words. As I have no personal knowledge of this subject, I have been compelled to rely on the opinions of others. There was a board of competent officers detailed for the express purpose of examining the whole light-house system, with the view of ascertaining what system ought to be adopted in order to make it effectual. That report was presented to Congress many months since. It was printed some two or three months ago. The Senator from Florida has not examined it. I should be disposed to rely upon his judgment, if it were not for the fact that competent officers, acquainted with the whole subject, have been appointed to examine it, and their report has been communicated to Congress. I do not see that in the proposed amendment the question is involved, what sort of lights shall be used upon our coast, whether the Fresnel light or the old light. The question
is, whether in order to make the light-house system what it should be—an effective one—it is necessary to establish a board to control the whole? In my judgment, it is necessary, and, therefore, although there may be defects in the bill, I am disposed to vote for the organization of that board. It will be subject to revision at the next session of Congress. I am unwilling that the subject should go over to the next session upon the assertion of Senators that they will bring in a perfect system. I have heard that same remark made with regard to other things which have been introduced into the Senate. I am anxious that the first step should be taken now to make the system an effective one. And in order to make it so, you must have some persons at its head who can give their personal attention to it, and who have sufficient ability to look into the whole. It is for that reason I desire that the board shall be established.

**Mr. Houston.** I must say that, until a measure of so much importance, involving the expenditure of so much money, is recommended by a committee, I am unwilling to go for it. I care not for the opinion of any board whatever, nor for its action, for I am satisfied, from the best information which I have been able to obtain upon this subject, that the expenditure will not be less than $4,000,000, and it will be a continued and increased expense to the nation. If the lights now are sufficient to operate as beacons to vessels, so far as the curvature of the earth does not interfere with them, I see no necessity for any improvement. I will never vote for a measure so universal, in which so many are interested, and which comes forward in such a manner as not to permit us to discuss or to investigate it on this floor. If it were a minor matter, thrust upon us at this moment, without discussion or time for reflection, I might be willing, through courtesy, to leave it to others and to permit it to pass; but I cannot support, or permit without the hindrance of my vote, any legislation of this character, that involves millions, when we know what influences out of the house are pressed upon Senators to rush it through, under the present pressure and haste of circumstances.

**Mr. Weller.** I desire to say to my friend from Texas that no outside influence has controlled my vote.

**Mr. Houston.** The Senator was not in my mind when I made the remark. I will assure him that I made no allusion to him.

**Mr. Weller.** The only thing which governs me is the report of the board of officers who have been selected to examine into the subject, because they were supposed to understand it; and I presume they do understand it better than I do. It is for that reason that I go with them.

**Mr. Cass.** Since I addressed the Senate before I have conversed with a gentleman here—a member of the House—and he tells me that this project was devised with great care and with great caution. He likewise removed another difficulty in my mind, as I had not read the bill. He states that the members of the board, whether those from civil life or those from the Army and Navy, are not to receive one cent. That removes a great difficulty. If, therefore, the vote is taken now, I shall vote in favor of the system.

**Mr. Desaussure.** There are so few of us here, that the opinion of each Senator may be of some consequence; and as I have paid some
attention to the subject, it is proper, perhaps, that I should state the
ground upon which I shall give my vote.
I am decidedly in favor of the sections of the bill which it is proposed
to strike out; and I say so because I have examined them. They have
been carefully prepared, although their provisions may be defective.
All new systems, however, are defective, and require to be improved after
time and experience have shown where the defects exist. I have no
doubt that there may be defects in this scheme. But it is a new under-
taking; it is a new enterprise. How was it gotten up? By the act of
1851, you authorized a Light-house Board to be appointed. That board
was appointed, and was composed of scientific gentlemen, some of them
officers of distinction in the Army and Navy. After a very elaborate
examination, the result of which I have somewhat carefully looked into,
they present you with the result to which they have come, which is that
the present system is essentially defective. They show you the fact that
the distribution of the lights is imperfect and unequal; that on some
parts of the coast—to wit: at the north—there is an accumulation of
lights far beyond what the exigencies of the case demand; so much are
they accumulated in some places that they are a nuisance to the navig-
ator instead of a benefit; and a great many of them are defective. At
the south there is a far less proportion of lights than at the north. They
ought certainly to be in the same proportion in the south as at the north,
and in some parts there ought to be a greater accumulation. But that
is not a sectional question. No question can be made on that score, be-
cause the north has occasion, in point of fact, to use the lights at the
south as much as those on their own coast. It is their commerce, their
ships that navigate along that coast, and it is important to them, to
escape shipwreck, to have the coast properly lighted.

There is one point of importance which is developed by the report of
that board. In some parts of the country people have been ever anxious
to come forward and insist on the necessity of having lights at different
points, and by urging it, have procured light-houses to be established in
neighborhoods where there was not much occasion for them. A good
deal of money has been expended in that way that need not have been
expended. That of course has not applied to all sections of the country.

We need reform, and an examination of that book will demonstrate it.
Gentlemen say they have not read the book. I am sorry for it. When
the Senate is called upon to act upon the subject, they ought to be pre-
pared. I could very well excuse my friend from Massachusetts if he
had not carefully examined it.

Mr. DAVIS. I have examined the report.

Mr. DESAUSSE. But he has examined it. I could very well excuse
him if he had not, because I know he is a very laborious Senator, and
his hands have been full of another subject, which he has elaborated
with great care, and to the great satisfaction of the Senate. I mean
the steamboat bill. But other Senators have said that they have not
examined the book. The Senator from Florida has not had it in his
power to do so. The evidence has been before us a great while. I
regret it has not been examined, for it is my firm conviction that if
Senators had examined the testimony, so elaborately prepared, and the
result of which has been set before us by the board which was appointed, they would all have come to the conclusion that I have come to, that this subject requires to be acted upon, and that promptly; and that that board has pointed out the proper mode of proceeding, though the plan which they suggest may be full of defects.

I regret to say that I have not come to the same conclusion with the Senator from Massachusetts. Instead of there being greater expenses entailed upon us by the reform which is advocated, I believe it is a cheaper system. I believe that by it you will greatly diminish the number of lights in some parts of the country, instead of increasing them. And although there may be an increase in other parts, yet, upon the whole, I have come to the conclusion that there will be an economy in the system which the board recommend. I have examined the difference between the dioptric light and the reflectors. It is true, the reflectors may answer in some parts of the country after they have been improved. With that alteration, I understand they are of a superior character, and may answer the purpose instead of the lenticular light. But the dioptric light, upon the whole, I think is the best. It may be that it will be the most expensive at the outset, but it is not the most expensive in the end. The first cost may be expensive, when you come to set up and establish one of these lights. As the French say, "C'est le premier pas qui conte"—it is the first step which costs. After that, the expense is comparatively small.

The system now presented to us has been elaborately prepared in the House in the bill which they have presented to us. I regret that no committee of the Senate has examined it carefully. The House has adopted it upon testimony which you yourselves directed to be prepared. I have examined it, and my judgment is satisfied that their system is right, and that it will be the cheapest. I know well that it will give a better light than the present. Unquestionably there are improvements to be made which they have not suggested, but I think they have devised the proper method of carrying out the work. The persons appointed under the act of last session to superintend the matter were competent to do it. I do not understand that the board which it is now proposed to establish is one which will claim any compensation out of the Treasury. On the contrary, it is to be composed of officers who belong to the Government, whose talents, whose time, whose services belong to the country. I understand that the services are to be performed by those parties. Why not try the experiment?

My friend from Massachusetts says all boards fail. I have not sufficient experience to speak with great certainty upon that subject, but I have known some boards to succeed. I have known some boards to carry out systems very well. When there was a new system to be struck out—a code of laws to be organized—I have known some boards, without compensation, patriotically to devote their attention to it, and elaborate it most successfully, and carry it into execution. They left it to other parties afterwards, who succeeded them, to continue that service. It may be in some instances that they failed. That may depend upon the persons selected. I believe, however, that you have a great many very intelligent, capable, and patriotic persons in your Navy,
whose attention could be turned to this subject. A great many of them are out of service; I may say they are out of active employment, at all events; and I have no doubt it would be a relief to them to be enabled to devote a portion of their time to the country. I think that the means for the selection and composition of this board are very large, and that Congress would be able to make such a selection as would carry out the purpose contemplated by the system.

Now, when you have the evidence, when you have been at great pains to procure it—when it has been methodized and reduced to a system—what objection is there made to the plan proposed? Why, that gentlemen had not time to examine it. It may be that it would have been better to have examined it, but, as was well suggested by the Senator from Maryland, [Mr. Pearce,] who preceded me, you are about to encounter the short session, and you will have very little time to arrange any great matters of this sort. The whole system cannot be carried out then. You have only three months; therefore, it strikes me now is the time to enter upon the system. It has been carefully prepared; it is before you; and I think we would better adopt it.

Mr. Hamlin. I do not wish to say anything more on this subject. All I desire is, that the Senate should vote upon the question.

Mr. Mallory. If I had perused the work alluded to by the honorable Senator from South Carolina, I should perhaps have come to the same conclusion that he has. I should have felt constrained, however, to have examined the work in connection with other evidence upon the same subject which is on file in the Treasury Department. I have no objection to—on the contrary, I am decidedly in favor of—improving, rather systemizing the plan of lighting the coast. I know the system is defective, but I have yet to learn that any of the mariners of this country, or of any other commercial people who trade with us, as a general thing, find fault with the lights on the coast. As to this work of nearly eight hundred pages, Senators will have an opportunity, between this and the next session, to give it a full and thorough examination.

Mr. Davis. There is nothing more true than the remark made by the Senator from Florida, as he took his seat, that the complaints against the present system do not come from the navigators. They spring up in Washington. They are made here by men who have no concern with navigation. Now, I am not surprised that my worthy friend from South Carolina, [Mr. Desaussure,] if he really believes all the statements which are contained in that book, as he seems to do, should be led to the conclusion that he adopts. But, sir, can all that is in that book be true? Is it possible that the lights in this country should be in such a condition as they are represented there, and yet give a reasonable degree of satisfaction to the public? As far as I recollect, in all that book, there is not one thing in the present system that the board approves of. I read it with some care and attention, and I was astonished at the declarations made in it; for while I will not deny that there are defects in it, yet in a system like this, which has stood more than half a century, to find no one thing to approve of in it is a little extraordinary. I hold that the report is an unfair, unjust, and an exagger-
ated statement of facts. I say this, with all due deference and respect to the gentlemen who put their names to that report. I suppose some other persons collected the testimony which they present—it was not obtained from their own observation; it has been derived from other sources, and they have been misled as to the facts.

I wish to add a word as to economy. My worthy friend from South Carolina thinks there is greater economy in the lens system, simply because it burns less oil. Now, you may go to the Department, and find that there has never been a lenticular light introduced which has not cost $10,000, independent of the structure and lantern in which it is put. You put the greater part of your lights into operation for some $3,000 or $4,000. Now, if economy is to be considered at all in the United States—and I do not know that it is—the system which we pursue is recommended by its economy; and that is one of the apologies for its defects; for whatever may be said of the administration of this department, it has always been economical, and always adopted views with a prudent regard to expenditure. There may be imperfect light-houses. I know there are. But, on the other hand, there are good houses. There may be imperfect reflectors. On the other hand, there are good reflectors; and all reflectors may now be made with suitable form—with a form that is mathematically correct. And when they are properly adjusted they are good lights. They may not give as much light as the lenses; but they are good lights, and they answer the public purpose at a much less expense. Many gentlemen can certainly understand me when I say that the economical comparisons in the report are made with lamps that light the whole horizon. They presuppose that you are to light the whole horizon. When you use lenses, you have but one lamp; and whether you want to light one-fourth, one-half, or the whole horizon, you use the same quantity of light. But every reflector has its own light, and as you diminish the reflectors, you diminish the quantity of oil consumed. The board do not suffer that to come into the comparison; and the effect is to mislead us on that point. I say that this whole subject ought to be scrutinized with care, and carried out with a careful and just consideration as to expense; and it should not be taken up and crowded down our throats on the very last days of the session, as it is now proposed to do. The bill which established the board that made this report was brought in here last year, under such an emergency that you could not read the title of it, and it was passed, upon a hasty vote, without reading. Then it took a man to run as rapidly as he could to the other house, to get in there so that it might be signed in time. That is the way this board was created; and it is now proposed to continue it in much the same way. I am opposed to it; but I am not opposed to a good or an improved system of lights.

Mr Pratt asked for the yeas and nays on the amendment, and they were ordered.

Mr. Houston. I have a great respect for the opinions of the Senator from South Carolina. Amongst others, he has given us one that this bill is defective. He has examined it thoroughly, and perused the authority upon which it is based, and he says it is defective. Now, we ought not
hastily to commence an important system, which is acknowledged to be defective, which is to lead to a great expenditure of money. We should make it perfect. The fact that a board of officers, competent for the purpose, should have reported in favor of a measure, commends it to my respect and investigation, but not to my support, or to its adoption in the Senate. I entertain due respect for the opinions of others; but if we are to constitute boards for the shaping out of subjects for this body to adopt, we would better, in the first place, and to save trouble, invest them with power to declare them as edicts, and become ourselves the registering power alone. If we have a right to do anything, we have a right to investigate the measures recommended by boards. I must confess that, in many instances, the reports of boards do not commend subjects to my favorable consideration, much respect as I may have for the gentlemen composing them. I am not always disposed to adopt their reports, because their opinions may be moulded by what is called here an outside pressure.

It is but this moment that the civil and diplomatic bill was finally passed in the House of Representatives by a single vote, owing, perhaps, to an obnoxious amendment introduced into it upon my motion. That seems to me to augur something to the Senate. That that bill should be passed by one single vote, and that the casting vote of the Speaker, speaks something of a most extraordinary character.

As the honorable Senator from Florida has said, we shall have ample opportunity for investigating this enormous volume between this and the next meeting of Congress, or during the next session; and then we will be enabled to vote understandingly upon the subject, instead of adopting it now; when I will venture to say two Senators of this body have not had the opportunity of comparing the testimony collected by these gentlemen, and endorsed by their opinion, with the evidence, of a most veritable character, registered in the Fifth Auditor's office. For this reason I cannot vote for the measure, but will vote for the amendment of the committee.

The question being being taken by yeas and nays, resulted—yeas 11, nays 28, as follow:

**Yeas**—Messrs. Brodhead, Clark, Davis, Dodge of Wisconsin, Hale, Hamlin, Houston, James, Mallory, Mangum, and Miller—11.

**Nays**—Messrs. Badger, Bayard, Borland, Bright, Brooke, Butler, Cass, Charlton, Chase, Cooper, Dawson, Desaussure, Dodge of Iowa, Downs, Felch, Fish, Gwin, Hunter, Jones of Iowa, Mason, Morton, Pearce, Pratt, Rusk, Spruance, Toucey, Wade, and Weller—28.

So the amendment was rejected.

The bill was then reported to the Senate as amended; the amendments were concurred in and ordered to be engrossed; and the bill was ordered to be read a third time. It was then read a third time and passed.
Organization of the temporary Light-house Board, under authority of the act of Congress approved March 3, 1851.

Captain W. B. Shubrick, United States Navy.
Commander S. F. Dupont, United States Navy.
Brevet Brigadier General Jos. G. Totten, United States Corps of Engineers.
Lieutenant Colonel James Kearney, United States Corps of Topographical Engineers.
Professor Alexander Dallas Bache, LL.D., &c., Superintendent United States Coast Survey.
Lieutenant Thornton S. Jenkins, United States Navy, Secretary.

Treasury Department, February 4, 1852.

Sir: I have the honor to transmit herewith the report of the Light-house Board, appointed by the Department in pursuance of the 8th section of the act of 3d March, 1851, entitled "An act making appropriations for light-houses, light-boats, buoys," &c.

Very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Hon. W. R. King,
President pro tem., U. S. Senate.

Treasury Department, May 21, 1851.

Gentlemen: By the 8th section of the act approved 3d March, 1851, entitled "An act making appropriations for light-houses, light-boats, buoys," &c., the Secretary of the Treasury is authorized and required to cause a board to be convened at as early a day as may be practicable after the passage of that act, to be composed of two officers of the Navy of high rank, two officers of engineers of the Army, and such civil officer of high scientific attainments as may be under the orders or at the disposition of the Treasury Department, and a junior officer of the Navy to act as secretary to said board, whose duty it shall be, under instructions from the Treasury Department, to inquire into the condition of the light-house establishment of the United States, and make a general detailed report and programme to guide legislation in extending and improving our present system of construction, illumination, inspection, and superintendence.

Having been advised that the board has met, as directed by the Department, has been organized by the election of Commodore William B. Shubrick as president, and is now prepared to proceed in execution of the duties assigned in the act of Congress, it is deemed proper briefly to refer to some of the more important subjects which will occupy its attention. By so doing, the Department does not wish to limit in any
way the range of the inquiries of the board, which, on the contrary, it desires may embrace all such matters relating to light-houses, beacons, buoys, and other aids to navigation, as may seem worthy of examination and report.

1st. The board is to inquire and report in regard to the condition of the light-house establishment of the United States; its efficiency and economy; the classification and distinction of the lights; the mode of ascertaining the proper places for light-houses and light-boats; the special selection of the sites of light-houses, and of obtaining their use; of procuring plans for the buildings and vessels, lighting apparatus and other accessories, such as alarm signals, &c.; of determining the materials, and mode of construction; of procuring them, and of the superintendence while under construction, or of securing the faithful observance of contracts; the condition of its towers, and other buildings, and of its light-boats; of its lanterns and other accessories; the perfection or imperfection of its illuminating apparatus; the character of the ventilation of the lanterns; of the attendance upon the lights, of the general police and regulation of the establishment, and especially of the cleanliness of the lighting apparatus; the regularity of lighting and of extinguishing the lights, and of the mode of securing it: the modes of procuring and delivering supplies, and of testing their quality; of securing the services of proper persons as keepers; the manner and frequency of inspections, and the persons by whom made; the direction, making, and supervision of annual repairs; the mode of determining the position in which beacons, buoys, sea-marks, and other aids to navigation. should be placed; of procuring and placing them; of replacing them when removed, and of numbering and coloring the buoys; and, finally, in regard to the manner of giving notice to mariners in regard to changes in lights, beacons, buoys, and sea-marks.

It is desirable that the board should compare the condition of some of the light-house structures erected at an early period, (as the tower of Sandy Hook,) with that of more modern ones, and ascertain, if practicable, the causes of the difference, if any, in their durability; that a full comparison of the system of lighting adopted in the United States should be made with that of Great Britain and France in reference to useful effect—to economy in first cost and in annual repairs—to durability and efficiency; that the systems of illumination by the best reflectors and the Fresnel lenses should be carefully compared, and the advantages and disadvantages of either be fully stated; that the cost of the gradual introduction of the French or lens system should be carefully ascertained and compared, in a period of say five years, as to useful effect and economy, with the cost of continuing the present system.

It is desirable that a complete descriptive list of the light-houses, light-boats, beacons, buoys, and sea-marks in the United States, should accompany the report of the board.

The Department will furnish all facilities to the board within its power for obtaining the information necessary to the discharge of its important duties, and will provide the books, maps, charts, and apparatus, which may be required.

Directions will be given to submit to the scrutiny of such of the mem-
bers of the board as may be charged with that duty, any of the light-
houses, light-boats, and their accessories, which they may deem it de-
sirable to examine.

Besides the examination into the present system, the law requires a
detailed report and programme to guide legislation in extending and im-
proving the present system of construction, illumination, inspection, and
superintendence.

The Department, therefore, desires the views of the board on these
subjects under the several heads heretofore enumerated, and expects a
detailed plan for lighting the coast of the United States, showing the
proper location of the sea-coast lights, and the best modes of arranging
them in one system, having reference to classification and distinctive
character.

It is desired that such a classification should be adopted as will be of
ready use, and include all sea and lake-coast, bay, river, and harbor
lights, and that such distinctive characteristics should be proposed as
may be best adapted to the several classes and circumstances of the lights.

In connection with the programme, the best means of ascertaining the
necessity for the introduction of new lights, for supplying them, and for
renovating old ones, should be pointed out. Suggestions in regard to
the discontinuance of unnecessary lights will be expected from the board.

The Department desires that the subjects on which instructions may
be deemed necessary to persons employed in connection with the light-
house establishment, and the best mode of securing attention to them,
should be pointed out.

The report of the board should also give in detail their views in regard
to the different materials for constructing light-houses, to the mortars
and cements which are or may be employed, and to the plans for founda-
tions and superstructures adapted to different localities.

In all points in which the present system is deemed by the board in-
adequate or unsatisfactory, the Department expects a detailed plan of
reorganization.

Facilities for the foreign and domestic correspondence necessary to
procure information will be afforded to the board by the Department.

The board is requested to give any information which it may obtain
in regard to improvements in the materials or modes of illumination in
light-houses.

The Department suggests to the board that it was doubtless te-oxh
pection of Congress that every practicable mode of securing the desired
information should be adopted, in order to receive the results of the in-
vestigation in time to be submitted to the next session of Congress.

Very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Commodore WILLIAM B. SHUBRICK, U. S. Navy,
Commander S. F. DUPONT, U. S. Navy,
Brevet Brigadier General JOS. G. TOTTEN, U. S. Corps of Engineers,
Lieut. Col. JAMES KEARNES, U. S. Top. Engineers,
Prof. A. D. BACHE, LL.D., Superintendent of Coast Survey,
Lieut. THORNTON A. JENKINS, U. S. Navy, Secretary.
REPORT.

Office Light-house Board,
Washington City, January 30, 1852.

SIR: The Light-house Board have the honor to submit the report of their investigations, and the conclusions they have arrived at, under your instructions of the 21st May, 1851, hereto appended, in conformity to the eighth section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851, in the following words:

"And be it further enacted; That the Secretary of the Treasury be, and he is hereby, authorized and required to cause a board to be convened at as early a day as may be practicable after the passage of this act, to be composed of two officers of the Navy of high rank, two officers of engineers of the Army, and such civil officer of high scientific attainments as may be under the orders or at the disposition of the Treasury Department, and a junior officer of the Navy to act as secretary to said board, whose duty it shall be, under instructions from the Treasury Department, to inquire into the condition of the light-house establishment of the United States, and make a general detailed report and programme to guide legislation in extending and improving our present system of construction, illumination, inspection, and superintendence: Provided, That no additional compensation be allowed to any person serving on said board."

The board, having entered upon the duties confided to them with a high sense of their responsibilities and importance, have spared neither pains nor labor in seeking to obtain facts, from their own observation and from reliable sources, upon the different points embraced in your instructions. They have sought for useful information also from reliable treatises and from public documents, and have endeavored to reach correct conclusions on the numerous points submitted to them.

The subject of light-house illumination and improvement, although one of occasional discussion in Congress and in certain circles within the last twelve or fifteen years, has not occupied the public mind to any great extent in this country, while in Europe generally, but more especially in France, England, Scotland, and Ireland, the ablest and most distinguished statesmen, philosophers, and philanthropists have devoted themselves for the last twenty-five or thirty years to this subject, in endeavoring to apply practically the aids which science and the mechanic arts have developed.

Experiments to ascertain the truthful practical tests of the relative useful and economical values of illuminating apparatus, combustibles, and their accessories, in the most minute detail, have been made by Fresnel, Faraday, Stevenson, and other distinguished individuals; the results of their investigations have been published to the world, and their conclusions have served for the formation of a system for light-house illumination, approximating to perfection.

Legislation, too, has taken a prominent part in this important branch of the public service in Europe.

In 1825 the French government adopted definitively the Fresnel system of illumination on the coasts of France, and took, as the basis of
their future light-house establishment, the programme proposed by the board organized for the purpose, at the head of which was Admiral Rossel, of the French navy.

About this time the subject, which Sir David Brewster had foreseen in 1811, was revived in England and Scotland, through Colonel Colby, of the royal engineers, and Mr. Stevenson, the engineer to the Northern lights, (and the distinguished architect of the Bell Rock tower.) However, no important step was taken on the English side of the channel to introduce the Fresnel apparatus until after a most careful and rigid examination had been made by the light-house engineer of Scotland, and after trials of comparative usefulness and economy with that and the reflector apparatus at the Inchkeith station.

In 1834 a new impulse was given to the subject of improvement in light-house illumination by letters from Sir David Brewster, and from the action of the House of Commons' select committee.

The light-house boards of Europe seemed to exert themselves to satisfy public opinion by the introduction of the Fresnel lens at a few of the most important points for land lights, and of improved apparatus for floating lights, consisting of the Argand lamps and parabolic reflectors in general use for land lights, prior to the introduction of the Fresnel lens, and movable machinery for converting such fixed floating lights as were necessary into revolving ones.

Although the lens met with much favor in England, and has been gradually getting into use, until nearly one-half the sea-coast lights have been changed since 1837, still Scotland has introduced a larger number, in proportion to extent of coast, than the Trinity House corporation. Notwithstanding these decided improvements in the lights of Great Britain, another select committee on light-houses was raised by the House of Commons in 1845, and, of the benefits arising from this last report, have been the introduction of a large number of lens apparatus, not only in Great Britain, but also into many of the colonies, and the substitution of the colza or rape-seed oil in nearly every light-house in the kingdom, in consequence of its superiority and economy compared to the best sperm oil.

Improvements in illuminating apparatus and construction, ventilation, combustibles, &c., have made rapid progress in light-house engineering in Europe; while in this country no attempt has been made to improve the lights, with the exception of the act of Congress approved July 7, 1888, and which was the result of the recommendation of the Committee on Commerce in the Senate, as follows:

"Sec. 2. And be it further enacted, That the Secretary of the Treasury be, and he is hereby, directed to cause two sets of dioptic or lenticular apparatus—one of the first, the other of the second class—and also one set, if he deems it expedient of the reflector apparatus, all of the most improved kinds, to be imported, and cause the said several sets to be set up, and their merits, as compared with the apparatus in use, to be tested by full and satisfactory experiment."

Under this authority a lens apparatus was placed in each of the towers at the Highlands of Navesink, and fourteen out of the fifteen reflectors were placed in the Boston light-house.
If "the said several sets" were "set up" and "their merits, as compared with the apparatus in use, tested by full and satisfactory experiment," in conformity to the act, the results of those experiments have not been seen by the board, nor have they ever heard that such experiments were made. With this exception, and the authority of Congress "to test Mr. Isherwood's plan of discriminating one light from another, and of determining the distance of a vessel from a light," which resulted in placing a second-order lens in the tower at Sankaty Head, Nantucket, and the lights authorized by law to be constructed under the direction of the Topographical Bureau, (Brandywine shoal, Carysfort reef, and Sand key,) the board have been unable to discover that any steps have been taken to keep pace in light-house improvements in this country with those of France and Great Britain.

The board, after examining, with a patience and a zeal which they believe this important branch of the public service to demand, the different points to which their attention was specially called by the instructions of the Department, have arrived at the following conclusions, which they feel assured will be found to be fully sustained by the detailed data in this report, and its appendix, upon which they are chiefly based:

1. That the light-houses, light-vessels, beacons, and buoys, and their accessories in the United States, are not as efficient as the interests of commerce, navigation, and humanity demand; and that they do not compare favorably with similar aids to navigation in Europe in general, but especially with those of France and Great Britain, and their dependencies.

That the light-house establishment of the United States does not compare favorably in economy with those of Great Britain and France.

That, while the superiority of the European lights to those of the United States (arising from the greater care and attention bestowed upon them, the better and more expensive apparatus employed in them, the larger number of keepers to the lights, the more rigid superintendence and frequent visitations for inspections and for delivery of supplies) renders any just comparison of them in annual expense in money impossible, it is shown that the difference for maintenance per lamp per annum is very small, and that not invariably in favor of those of this country.

That the towers and buildings have not been constructed in general of the best materials, nor under the care and supervision of competent or faithful engineers.

That the want of professional knowledge of the materials, mortars, cements, &c., for construction and repairs, or faithfulness on the part of those charged with the duty, was apparent in nearly all the modern towers and buildings visited by the board.

That the present large sums annually required for renewing, renovating, and repairing towers and buildings, are the consequences of the want of an efficient organization, which could afford the necessary professional ability for plans, drawings, and superintending of constructions and repairs.

That the towers are deficient in the necessary proper accommodations for oil and other supplies; in the mode of fitting them up, and in the
materials employed for the interior work; and the buildings ill adapted to the comfortable accommodation of the keepers.

That the lanterns are, as a general rule, of improper dimensions, constructed of ill adapted, and, in the end, not economical materials, without professional or scientific skill; and, in many instances, not suited to the use for which they are designed.

That there is no proper system of ventilation for lanterns.

That the means said to be employed for ventilating are wholly inadequate, and contrary to true scientific principles.

That there is very little attention paid to the painting of the interior of the lanterns and astragals, and in glazing.

That, under a well-organized system, the lights, and other aids to navigation, might be greatly increased in number and efficiency, at a large saving upon the present annual cost.

That there has never been an efficient systematic plan of construction, illumination, inspection, and superintendence of lights, &c., in the United States.

That towers and buildings have been constructed without regard to the wants of the service, and to the peculiarities of localities, and the special design of the lights themselves.

That the light-house towers, buildings, and vessels visited by the board were not, in general, found to be in a creditable state of preservation and repair.

That the inferiority of illuminating apparatus in the light-houses of the United States renders its renewal frequently necessary, at great expense, and never produces as effective a light as it is capable of making.

That the reflector apparatus employed in the light-houses of the United States is greatly inferior to the requirements of the service, being defective in form, materials, and finish.

That the illuminating apparatus in the United States is of a description now nearly obsolete throughout all maritime countries, where the best apparatus of that description was employed, prior to the introduction of the Fresnel lenses, as substitutes.

That the sea-coast reflector lights are, in general, too low, and are deficient in power and range.

That our sea-coast reflector lights are not fitted with a sufficient number of lamps and reflectors to produce the greatest amount of usefulness, which the imperfect system of lighting with the reflectors will produce.

That the lamps and reflectors are not, as a general rule, properly placed on the frames, due regard not being paid to divergency.

That the sea-coast lights are deficient in proper attendance, with only one keeper.

That there is no proper classification of lights in the United States.

That the lights are not properly and sufficiently well distinguished along the coast of the United States.

That there is no system of public inspection and superintendence, calculated to render the light-house establishment moderately useful or efficient.

That the lanterns, illuminating apparatus, &c., are not superintended, while they are being made, by competent or faithful professional men.
That there are no general or special regulations for keepers and others connected with light-houses, by which to insure an intelligent or faithful performance of the duties.

That supplies of all kinds, involving the good or bad quality of the lights to a great extent, are not tested and selected by competent persons before issuing them to light-keepers.

That there is not a proper degree of responsibility on the part of the agents connected with the light-house establishment.

That the present mode of procuring and distributing supplies, apparatus, &c., is not calculated to insure either efficiency or economy in the service.

That contractors are not held under a sufficiently rigid superintendence and inspection during the execution of works of construction and repair.

That the modern light-house towers are inferior in point of materials and workmanship to the older ones visited by the board—such, for example, as Sandy Hook light-house, built in 1762; Cape Henlopen tower, built in 1764; Cape Henry tower, built in 1791.

That the floating lights of the United States are comparatively useless for want of efficient lamps and parabolic reflectors.

That the light-vessels are in general not adapted to the service they are required to perform, being defective in size, model, and moorings.

That the light-vessels are not properly distinguished either by day or by night.

That sufficient regard has not been had to the proposed use of the several lights, so as to regulate their power and range accordingly.

That there is no effective system by which to afford to sparsely-settled parts of the coasts requiring lights the means of bringing the subject before Congress, and deciding in advance of appropriations the best descriptions of lights to be placed at the desired points.

That many of the small lights have an unnecessary number of lamps and reflectors, while sea-coast lights are greatly deficient in them.

That in the form and adjustment of the reflectors, sufficient attention is not paid to the range and other circumstances of the required lights, involving scientific principles.

That there is not, in useful effect, a single first-class light on the coast of the United States.

That the lights at Navesink (two lenses) and the second-order lens light at Sankaty Head, Nantucket, are the best lights on the coast of the United States.

That there are very few, if any, reflector lights on the coast of the United States better in useful effect than the third-order lens light (larger model) erected by the Topographical Bureau on Brandywine shoal, while the economy of the lens light is in the ratio of at least 4 to 1.

That the lens lights at Navesink, Sankaty Head, and Brandywine shoal are considered to be, as a general rule, equal to European lights of the same classes.

That the Fresnel lens is greatly superior to any other mode of lighthouse illumination, and in point of economy is nearly four times as advantageous as the best system of reflectors and Argand lamps.

That the buoys in the waters of the United States are defective in
size, shape, and distinction, as a general rule, and that sufficient care is not taken, nor competent persons employed, to place, moor, and replace them.

That the moorings of buoys are not sufficiently heavy, and the chains not properly tested as to size and strength.

That the sea-coast lights along the southern coast from the Highlands of Navesink are comparatively useless to the mariner for want of sufficient power and range.

That the dangerous obstructions to navigation around Cape Florida, from the Gulf of Mexico, are not properly lighted and otherwise marked to aid navigators.

That the entire southern coast of the United States requires additional lights and other aids to navigation to render human life and property safe.

That, for want of an efficient organization, there is no systematic plan adopted on any part of the coast of the United States for rendering navigation safe and easy by means of lights, beacons, buoys, &c.

That lights and other aids to navigation are provided, as a general rule, through the action of Congress upon the petitions emanating from persons having a local interest, or from boards of pilots, insurance offices, chambers of commerce, &c.

That under a proper organization the officers of the light-house establishment would collect information from reliable sources, decide upon the doubtful points, and recommend to Congress all cases of sufficient importance to warrant appropriations.

That the approaches to some of our principal and most important harbors, bays, &c., are not sufficiently lighted and marked to render steam navigation as rapid, easy, and safe as the wants of commerce demand, especially to New York, Delaware, and Chesapeake bays, and some of their tributaries.

That the duty of lighting and marking with beacons, buoys, and seamarks, our extended sea, lake, gulf, bay, sound, and river coast, efficiently and economically, can only be performed by persons of professional experience and undoubted ability upon a systematic plan, based upon the principles of the most approved light-house engineering.

That there is no efficient system of inspection and superintendence of lights in the United States.

That the light-keepers, in many cases, are not competent, and in no instances have they been instructed in reference to their duties, nor examined to ascertain their ability to perform the duties faithfully.

That the supplies of oil, chimneys, wicks, &c., are not tested and selected with sufficient care, or by competent and faithful agents.

That there is no proper system of distributing the supplies to light-keepers.

That proper attention is not given to purchasing and distributing supplies.

That the cleaning powder used in our light-houses is injurious to the reflectors, and not such as is used in other light-house establishments; and other articles are equally defective.
That there is no system in the management of the light-house establishment of the United States.

That the instructions to light-keepers to light, trim, and extinguish the lights at certain specified times, are not enforced, to the detriment of the service, and to the imminent risk of endangering vessels in their vicinity.

That such knowledge is not imparted to light-keepers, as a general rule, to enable them to keep their lamps, burners, reflectors, and lanterns in such order as to insure the best lights from the existing apparatus.

That frequent and rigid inspections and superintendence by competent persons are necessary to insure an efficient and economical light-house service.

That competent keepers, responsible to the Government through inspectors, are indispensable to insure good lights at all times.

That supplies are not delivered at sufficiently short intervals of time to the lights.

That the present mode of repairing illuminating apparatus, oil tanks, &c., is not economical, efficient, or reliable.

That the removal and replacing of light-vessels, the extinguishment or lighting of lights, removal or placing of buoys, &c., or in any manner changing lights and other aids to navigation, without giving ample notice, are subjects of grave complaint.

That there is no good reason why the light-vessels on the coasts of the United States (if properly constructed and moored) should not remain at their moorings under as unfavorable circumstances as those on the coasts of England and Ireland.

That whenever light-vessels are reported to have parted their moorings, the circumstances attending them should be carefully investigated by competent and disinterested persons, and the result made known.

That the erection of light-house towers of a uniform height, without regard to the elevation of the land upon which they are placed, is contrary to the first principles of light-house engineering, involving, in situations of great natural elevations above the level of the sea, unnecessary expense, and on low coasts the inefficiency of the light for want of sufficient range.

That due regard has not been had to the wants of commerce in selecting sites for lights along the coasts of the United States.

That for want of a proper system in this branch of the public service, the densely-populated coasts have a superabundance of lights, to the injury of navigation, while on the sparsely-settled coasts, bounding the great outlet to the millions of commerce from the valley of the Mississippi and its tributaries for hundreds of miles, there is not a single light.

That light-house construction, illumination, inspection, and superintendence, involve a large amount of special and general professional knowledge of a high character, and therefore should only be intrusted to the most competent professional persons.

That competent engineers have not been employed, except in a few instances, to plan and superintend the construction and fitting up of the light-houses of the United States.

That the large amounts required annually to repair and keep in good
order the towers, buildings, vessels, and illuminating apparatus of the
lights in the United States, is attributable to the manner in which the
work was executed, and to the inferiority of the materials employed.

That large sums are now required to preserve foundations of light-
towers, sea-walls, &c., which might have been saved by the adoption, by
competent engineers, of proper plans and foundations for them.

That no systematical and economical plan of construction has been
employed in the light-house establishment.

That changes are constantly taking place in the aids to navigation,
without any official notice being given to the public of them, which are
calculated to mislead mariners.

That there is no proper system of beaconage and buoyage, nor any
list by which the navigator, who is not familiar with the coast, can de-
rive any benefit.

That the list of light-houses and light-vessels is defective in many re-
spects; and it, at present, affords very little information to the navigator,
and is, in some respects, erroneous.

That there is no regular systematic or effective mode of giving notice
to mariners of proposed changes in lights, &c., or of any that may have
been destroyed or removed by the action of the sea or winds.

That the buoys are not properly painted according to law, nor are
they in other respects properly distinguished one from another.

That light-houses and light-vessels are not sufficiently well distin-
guished by day.

That the buoys are not properly placed, nor replaced when driven
from their positions, and without delay.

That buoys are not placed upon new shoals, over wrecks, &c., except
by a special act of Congress, through the agency of some philanthropic
or interested person.

That spare buoys are essential for all harbors and rivers in sufficient
numbers to allow for all casualties, and for cleaning, painting, &c.

That there is no code or manual of instructions to guide light-keepers
and others connected with the light-house service, in the performance of
their duties, in this country, as is found in every well-regulated light-
house establishment elsewhere.

That there is no meteorological reason for the lights of the United
States being worse than those of equal class and importance in England
and France.

That there are no proper books of daily expenditure kept; no returns
of daily expenditure made of a reliable character; and the lights are
deficient in all the essentials for the faithful performance of this duty,
such as books, forms, registers, &c.

That light-keepers should be required to devote all their time to the
care of the lights under their charge, and should not be allowed to attend
to their ordinary affairs to the injury of the service.

That if all our present lights were fitted with lens apparatus of equal
power to the reflectors now in use, the annual expense for supplies of
oil and cleaning materials would cost little more than one-fourth as much
as is now expended for these articles of supply annually; that is, that
the supplies now costing upwards of $152,000, would not exceed $38,000 to $42,000, making an annual saving of $110,000 to $115,000.

That in addition to the greater superiority in brilliancy, power, and economy of the lenses, compared to the reflectors, they possess the great advantage of durability, to the extent of never requiring to be renewed.

The board, therefore, recommend—

That the general programme for improving the sea-coast lights of the United States, and of making necessary additions, be adopted as the basis of future recommendation and legislation.

That the Fresnel, or lens system, modified in special cases by the holophotal apparatus of Mr. Thomas Stevenson, be adopted as the illuminating apparatus for the lights of the United States, to embrace all new lights now or hereafter authorized, and all lights requiring to be renovated either by reason of deficient power or of defective apparatus.

That the board respectfully recommend to the honorable Secretary of the Treasury to direct that, pending the future action of Congress on the subject of light-house improvements, the seventh section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851, in the following words:

"SEC. 7. And be it further enacted, That hereafter, in all new light-houses, in all light-houses requiring new lighting apparatus, and in all light-houses as yet unsupplied with illuminating apparatus, the lens, or Fresnel system, shall be adopted, if in the opinion of the Secretary of the Treasury the public interest will be subserved thereby,"—be strictly carried out, and that the necessary illuminating apparatus to fit up the light-houses now authorized to be built shall be of the lens system.

That a rigid and frequent inspection and superintendence by competent persons is essential to an efficient light-house establishment, and the board, therefore, recommend the appointment from the Army and Navy of a suitable number of inspectors for the lights and their accessories, throughout the United States.

That the present light-house establishment requires a thorough organization to insure to the service efficiency and economy; and therefore the board recommend the organization of a Light-house Board, to be composed of scientific civilians, Army and Navy officers, to be charged, by law, with the entire management of the light-house establishment of the United States.

That all sea-coast and other first-class lights should have not less than two keepers, including all first and second-order lens lights.

That all constructions, renovations, and repairs of towers and buildings, be hereafter made upon the plans, estimates, and drawings, and under the personal superintendence of an officer of engineers of the Army, in conformity to the ninth section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851.

That the lanterns, and all apparatus for illumination, ventilation, &c., be constructed under the personal superintendence of an officer of engineers of the Army.

That the sea-coast lights be increased in power and range.

That all light-vessels not yet fitted with illuminating apparatus, requiring to be renovated, and all that may hereafter be authorized by
law, be fitted with the best system of lamps and parabolic reflectors, both for fixed and revolving lights.

That more attention be given to the subject of models for light-vessels, constructing and mooring them, so as to give greater assurance to the navigator that they will be always found in position.

That light-vessels be painted and fitted with distinguishing marks by day, to enable the mariner to know them without difficulty.

That there be a uniformity in painting, marking, and distinguishing beacons; and that no one be allowed to change the color or distinguishing marks of any beacon, sea-mark, or light-house, without authority from the proper office at Washington, and after ample notice shall have been given through the medium of the commercial papers of greatest circulation, and by placards distributed at the different custom-houses, both at home and abroad, and among consuls and commercial agents of maritime nations.

That the buoys be made in size to subserve their proposed purpose, and that different shapes be employed for different channels, dangers, &c.

That competent professional men be required to make frequent inspections of the lights and other aids to navigation along the entire coast.

That supplies of all kinds undergo a most rigid test and scrutiny by a professional person of high moral and social standing, before issuing them to light-keepers.

That light-keepers undergo an examination before being placed in charge of any light, and that they be instructed by a competent person upon the detail of all the duties confided to them.

That instructions, rules, and regulations, embracing every point of duty, be drawn up in clear, plain, and explicit terms, suited to the capacities of the persons for whose benefit they are prepared, and distributed to the light-keepers and others connected with the service; that the general rules and regulations be printed in large type, with conspicuous headings, and framed, so that the keepers may always have access to them; and those more in detail to be well bound, and the keepers required to transfer them to their successors should they leave the lights.

That frequent and rigid inspections of lights by districts be made by competent professional men, and that they make regular returns to the head of the light-house department.

That the keepers be required to keep meteorological and tidal registers, in addition to the necessary returns of the daily consumption of oil and other supplies.

That no light-house keeper be appointed who cannot read and write, and is not in other respects competent to the faithful discharge of the duties.

That a mode of supplying persons employed at lights on rocks or other isolated points, on board of light-vessels, &c., with rations, to enable them to devote their entire time and attention to the duties, should be adopted.

That light-keepers be required to devote their entire time and attention to their duties on pain of dismissal, and in no case should a keeper be allowed to follow any other vocation to the neglect of the light.
That no keeper be allowed to be absent from the light without a positive written permission from the district inspector.

That no one but a regularly-appointed keeper, and his assistant or assistants, be permitted to attend to the apparatus, lighting, &c., of a light-house or light-vessel.

That the best cleaning powders, rags, &c., trimming scissors, and other necessary articles for keeping good lights, be furnished to the keepers; and that they be instructed that, under no pretext, should they employ any other means for keeping their apparatus in good order than those pointed out in the printed instructions from the department.

That proper curtains be provided for the apparatus of each light house, &c.

That light-vessels never be removed from their stations for repair without first placing a substitute; and in the event of a light-vessel parting her moorings, then that position be occupied without delay by a substitute.

That proper lists for the supply of each class of light-house, according to order or number of lamps, be made, and the person charged with the delivery of supplies be guided by it alone, without any discretionary power to increase, lessen, or change the quantity of articles to be on hand on a certain day.

That all the articles of supplies be selected and tested by persons of professional ability and standing.

That the necessary steps be taken, without delay, to ascertain what additional aids to navigation are necessary in the bays of New York, Delaware, and Chesapeake, and their tributaries, to enable steamers and other vessels to enter them at night, and proceed direct to their destination.

That hereafter, buoys required to be placed over newly-discovered shoals, or over vessels wrecked in or near channels, or where they may endanger vessels, be placed without delay, and the expense be defrayed from the general appropriations for buoys.

That larger and better distinguished buoys be placed to mark the channels of our principal bays and harbors, especially New York bar and bay, Delaware and Chesapeake bays, &c.

That appropriations be asked for two first-class light-vessels, to be fitted up in the best manner with the most approved reflector or refractor apparatus, and with proper distinguishing characteristics—one for the South shoals off Nantucket, and the other for Frying-Pan shoals, off Cape Fear—to be placed in the best positions for aiding navigators, under the Superintendent of the Coast Survey.

That appropriations be asked for renovating, and for first-order lens apparatus, for the lights at Cape Hatteras, North Carolina; Cape Florida, Florida; Dry Tortugas, Florida; Cape Canaveral, Florida; Cape Romain, South Carolina; Fire Island inlet, New York; Cape Henlopen, Delaware; Cape Henry, Virginia; Gay Head, Massachusetts; Montauk point, New York; and for the following new lights, to be fitted with first-order lenses, viz:

One, half way between Montauk point and Fire-Island light-house, Long Island; and one between Jupiter inlet and Gilbert's bar, Florida.
That the appropriation for Flynn's Knoll light-house be changed to authorize range beacons for New York harbor.

That an appropriation be asked for a bell-beacon for Flynn's knoll.

That, as the foregoing recommendations can only be thoroughly carried out under the orders of a properly-organized bureau or board, and as it is of vital importance to the interests of commerce and navigation, and of great importance, in an economical point of view, that the present light-house establishment should be improved as rapidly as possible; to carry out these suggestions, it is further recommended:

That a Light-house Board be created, by authority of law, to be attached to the Treasury Department, with power to provide rules and regulations for their meetings and proceedings, and for discharging, under the superintendence of the Secretary of the Treasury, all the duties appertaining to the management, maintenance, repair, renovation, illumination, inspection, superintendence, and construction of light-houses, light-vessels, beacons, buoys, and their appendages, in the United States.

That the Secretary of the Treasury, as ex-officio president, with two officers of the Navy of high rank; one officer of the corps of engineers of the Army; one officer of the corps of topographical engineers of the Army; and two civilians, of high scientific attainments, whose services may be at the disposal of the President, as members; and an officer of the Navy, and an officer of engineers of the Army, as secretaries, shall constitute the Light-house Board of the United States.

That the Light-house Board be authorized to appoint their chairman, to preside during the absence of the president, and perform such other duties as may be required by their rules and regulations.

That the Light-house Board be authorized to prepare such rules and regulations as shall be necessary for securing an efficient, uniform, and economical system of light-house administration, and for securing responsibility in the inspectors, keepers, and others connected with the light-house service, subject to the approval of the Secretary of the Treasury, and which, when approved, shall be respected and obeyed, until altered or revoked by the same authority.

That the Light-house Board be required to meet four times a year, and subject to be convened by the Secretary of the Treasury, whenever, in his judgment, it may be necessary for the transaction of general or special business, a majority of whom shall constitute a quorum.

That such clerks as are now employed on light house duties in the Treasury Department may be transferred to the Light-house Board, without any increase of salaries; that the necessary accommodations for the clerks, secretaries, for the preservation of the archives, drawings, &c., and for holding the meetings of the board, be provided in the Treasury Department.

That all archives, books, drawings, models, &c., belonging to the light-house establishment, may be transferred to the Light-house Board, for their use, in the discharge of their duties.

That the President be authorized and required to appoint, from the Army or Navy, an inspector of lights, beacons, buoys, &c., for each light-house district, to be arranged by the board, with the approval of
the Secretary of the Treasury; which inspectors shall be under the orders of the Light-house Board.

That the Light-house Board be authorized to prepare and distribute among the light-house keepers, inspectors, and others connected with the light-house establishment, such rules, regulations, and instructions, as may be necessary to secure an efficient, uniform, and economical system of administering the light-house establishment of the United States, and to secure responsibility from them.

That the Light-house Board be authorized and required to cause to be prepared by the engineer secretary of the board, or by such officer of engineers of the Army as may be detailed for that service, all plans, drawings, specifications, and estimates of cost, of all illuminating and other apparatus, and of construction and repair of towers and buildings, &c., connected with the light-house establishment; no bids or contract being accepted or entered into, except upon the decision of the board, at a regular or special meeting, and through their properly authorized officer.

That, hereafter, all materials for the construction and repair of light-houses, light-vessels, Beacons, buoys, &c., shall be procured by public contracts, under such regulations as the board may from time to time adopt, subject to the approval of the Secretary of the Treasury, and all works of construction, renovation, and repair, shall be made by the orders of the board, under the immediate superintendence of their engineer secretary, or of such engineer of the Army as may be detailed for that service.

That it shall be the duty of the Light-house Board to furnish, upon the requisition of the Secretary of the Treasury, all the estimates of expense which the several branches of the light-house service may require, and such other information as may be required, to be laid before Congress at the commencement of each session.

That all acts and parts of acts inconsistent with these recommendations, be repealed; and all acts and parts of acts relating to the light-house establishment of the United States, not inconsistent with these recommendations, and necessary to enable the Light-house Board, under the superintendence of the Secretary of the Treasury, to perform all duties relating to the management, construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, sea-marks, and their accessories, including the procuring and testing of apparatus, supplies and materials of all kinds for illuminating, building, and rebuilding when necessary, maintaining, and keeping in good repair the light-houses, light-vessels, buoys, beacons, and sea-marks of the United States; and the second and third sections of the act making appropriations for light-houses, light-vessels, beacons, buoys, &c., approved March 3, 1851, be declared to be in full force, and have the same effect as though the Light-house Board had not been created.

That no additional salary be allowed to any civil, military or naval officer who shall be employed on the Light-house Board, or who may be in any manner attached to the light-house service of the United States; and that it shall be unlawful for any member of the Light-house Board, inspector, light-keeper, or other person in any manner connected with
the light-house service, to be engaged, either directly or indirectly, in any contract for labor, materials, or supplies for the light-house service, or to possess, either as principal or agent, any pecuniary interest in any patent, plan, or mode of construction or illumination, or in any article of supply for the light-house service.

With such a board for the care and management of our present large and daily increasing light-house establishment, composed of the best adapted materials, from civil, military, and naval life, our lights must not only rapidly improve in efficiency, but also in economy.

By the assistance of the officers proposed as inspectors, and the two secretaries of the board, a general and systematic plan of classification, distinction, illumination, construction, repair, inspection, and superintendence, will, in a short time, be introduced, to the great advantage of commerce and navigation, and to the economy of the service.

The engineer secretary, with the assistance of officers of engineers now authorized by law to superintend the construction and renovation of light-houses, &c., will be able to prepare plans, estimates, and specifications of proposed works of construction and repair, and give a general superintendence to the lights, beacons, and buoys along the entire coast. The board will be able, at the close of the first fiscal year after it is in operation, to make detailed returns of expense of apparatus, combustibles, &c., exhibiting at one view the actual annual expense of every light on the entire coast; examine into the best modes of construction for special positions; make necessary experiments upon apparatus, oils, gases, &c., for light-house purposes; and determine, from information derived from their own and other competent officers, what increased aids are necessary along the coast to recommend to Congress.

They would in a short time be able to furnish to navigators clear and full descriptive lists of the lights, beacons, buoys, sea-marks, &c., with such notices of them as may be necessary to guide them in making our coast in tempestuous weather, and which could be reprinted at short intervals of time, if necessary, to point out new structures or changes. The coast survey charts would then be furnished with an account of every change of position or character of lights, buoys, beacons, &c., which would enhance their present great value to the navigating community.

Under an efficient organization, such as the one proposed, the duty would be performed better and more economically than at present, and there would be great saving in the end by affording to Congress estimates for proposed new works, rejecting works not considered necessary, and by introducing a class of structures which would require much less annual expense for repair than those now existing.

The ablest engineers of the Army would be called upon to decide upon plans for structures in cases involving doubts; the best and most durable illuminating apparatus would either be imported or fabricated in this country under the immediate eye of the officers of the board, and, when ready, be placed properly in the lanterns by the engineer charged with the work.

Boards for the execution of important duties are not novelties even in this country. Some, and indeed nearly all, of the most important un-
undertakings which this Government has ever embarked in, have been
planned and executed under the general supervision and management of
boards.

They are found in nearly every branch of our civil and military insti-
tutions, of every name, and for almost every purpose. They have been
successfully tried for this special purpose in France, where the savans
of the Academy of Sciences, without fee or reward, sit side by side with
the minister of state, the officer of the navy, and the engineer. In Eng-
land, the Duke of Wellington presides, while the prince, the peer, the
admiral, the commoner, and the retired sea-captain, sit together and de-
vote means for alleviating the hardships and lessening the dangers of the
mariner in approaching their dangerous coast.

In Scotland this important branch of the service is under the manage-
ment of a board composed of the sheriffs of the counties, lawyers, and
other civilians, who meet four times a year, without any remuneration,
to transact business connected with the lights of Scotland.

In addition to these meetings, there are numerous standing commit-
tees, some of which meet as often as once a fortnight for the transaction
of business, which is reported to the general meetings for their sanction
and approval. There is attached to this board a secretary and an engi-
neer, who is the executive officer, upon whom devolve all the scientific
details of construction, repairs, and illumination.

In Ireland there is also a board charged with the management of
light-houses, &c., with a secretary, engineer, &c.

This board, as in Scotland, is composed chiefly of philanthropic civil-
ians and an English admiral. The fact of Scotland and Ireland having
no army or navy, and no distinct commercial marine, will readily account
for such an organization, in which no motive, other than the praise-
worthy one of doing good, could prompt individuals of standing, wealth,
and distinction to perform the drudgery of so laborious an office without
pecuniary remuneration.

There is not a harbor in England, of any note, that has not its “Trinity
Board,” or “board of trustees,” charged with the lights, beacons, and
buoys; such, for example, as Liverpool, Newcastle-upon-Tyne, Hull, &c.,
under all of which the lights are managed in a manner worthy of the
highest commendation, both for efficiency and economy.

It is thus seen that the best-managed lights of Europe are under the
management and direction of boards, with proper officers, to assist them
in their duties. That this service should be deemed sufficiently honor-
able in France, Scotland, &c., to be performed gratuitously, is not so
much to be wondered at when we recollect the high standard of excel-
ence it has reached through the instrumentality of the philanthropic
individuals constituting those light-house boards.

In concluding this part of their report, the board consider it their
duty to urge upon Congress the necessity for a change in their present
management of our Light-house Establishment.

In investigating the subjects confided to them, they have endeavored
to reach the truth from observation and research. That they have not
done injustice to any one, they feel perfectly conscious; to have passed
over palpable defects in the present management of our lights, involving
great loss of human life and property, without pointing them out, would have been culpable and unpardonable; and that they have looked as leniently as possible on many points considered exceptionable, it is believed will be clearly shown by their report.

The board have not sought so much to discover defects and point them out, as to show the necessity for a better system. Commerce and navigation, in which every citizen of this nation is interested, either directly or indirectly, claim it; the weather-beaten sailor asks it, and humanity demands it.

GENERAL CONDITION OF THE LIGHT HOUSES, &c., OF THE UNITED STATES.

1. To ascertain the general condition of the lights of the United States, the board adopted several modes:

First, to visit a sufficient number of light-houses and light-vessels on different points of the coast, and to ascertain their condition by actual examination, and by inquiring of those employed in them.

Secondly, to make inquiries of intelligent nautical men commanding United States mail and other sea-steamers, packets, and other sailing ships, making over-sea voyages, chiefly between American and European ports, civilians, and officers of the Navy.

Thirdly, by inquiries addressed to the general superintendent of lights, and to local superintendents, to ascertain the views and principles upon which the action of the general system and its local arrangements were based.

2. It was soon apparent to the board, that any extended detailed inspection of lights, &c., would be a waste of time and money, and that it was only necessary to examine such lights as were characteristic and afforded the best specimens of the several kinds, such as the Boston light, fitted with reflectors made in London; the lens lights at Navesink, N. J., Sankaty Head, Nantucket; and the gas light at Reedy island, Delaware bay; or such as, from the importance of their position, should be types of the class to which they belonged; as Cape Elizabeth, Maine; Isle of Shoals, off Portsmouth, New Hampshire; Sandy Hook, New Jersey; Cape Henlopen, Delaware; and Cape Henry, Virginia, for sea-coast lights; Portland, Portsmouth, Boston, New Bedford, New York, Baltimore, and Old Point Comfort, for harbor lights, and such as would show any differences due to locality on the different parts of the coast.

3. A set of questions was prepared, and a list of points upon which information was required, was made so as to embrace the facts desired to be ascertained in these inspections.

In reference to the condition of the lights, &c., visited, the following is submitted by the board, as embracing a general view of them:

_Lens or Fresnel apparatus._

The first point visited by the Light-house Board for inspection and examination, was the two lights on the Highlands of Navesink, New Jersey.

As the lights at Navesink—the second-order lens light recently lighted
at Sankaty Head, Nantucket, and the third-order lens at Brandywine shoal—are the only lens lights on the coast of the United States, they will be referred to, and reported upon, without regard to the time the visits were made.

*Lights at the Highlands of Navesink, New Jersey.*

There are two towers at this station, having an elevation above the level of the sea of about 250 feet—one fitted with a first-order catadioptric fixed apparatus, and the other with a second-order revolving catadioptric apparatus. The apparatus employed in these two towers was constructed by M. Henry Lepaute, in Paris, by order, and under the superintendence of Commodore Perry, United States Navy, who was directed by the Government to purchase apparatus constructed on the principle of M. Fresnel, in obedience to a special act of Congress appropriating the necessary funds for the object, approved July 7, 1838.

These towers were elevated and otherwise improved to receive this apparatus, with the view, as it was understood, to test the alleged superiority of this mode of illumination to that employed in the light-houses along the entire coast of the United States.

A first-order fixed lens light was thus placed by the side of a second-order revolving lens light, with the view to distinction, disregarding the relative powers of the two sets of apparatus.

Although this apparatus, at the time it was constructed and received, was of the most approved description, and equal to the best in Europe, subsequent improvements have rendered it inferior to the illuminating apparatus of the same orders employed in recently-erected or recently renovated towers in those countries, especially in those of France, England, Scotland, and Ireland; yet, at the present time, the Navesink lights are justly esteemed by intelligent navigators and others, who have compared them, as the best lights on the coast of the United States.

The mirrors, constituting a most essential portion of the apparatus in these towers, are, with very few exceptions, out of adjustment, and otherwise greatly neglected, to the serious injury of the lights in brilliancy and power. Neither the refractors nor mirrors have received that attention and care which an intelligent and properly instructed keeper would have insured to them.

The keeper has no knowledge of the mode by which the apparatus can be adjusted, nor is there any competent person employed to perform that important service; nor is there any one charged with the repair of the mechanical lamps and machinery for the revolving light.

The principal keeper, without having had any instruction or previous knowledge of the machinery to enable him to perform faithfully these important duties, endeavors to do so, but is wholly unable to adjust the mirrors and keep the machinery for the revolving light in proper order.

The present principal keeper of these lights entered upon his duties about two years since, without having been previously subjected to any examination to test his ability to perform the duties, or his fitness for so important a trust. Four assistants are allowed to these two lights; those found at the station by the present keeper remained with him until he
thought proper to dismiss them, which he did, and appointed their successors, without consultation with, or the approval of, any one.

A small printed work, purporting to be a translation of the instructions to the light-keepers in France, and the printed letter from the office of the Fifth Auditor, directing the keeper to light his lights at sunset, and extinguish them at sunrise, and to keep a bright, clear light, during the night, &c., are the only guides in the possession of the keeper to the performance of his duties.

The lights are not lighted at sunset, but at dark; and are not kept burning until sunrise, but are extinguished at daylight. The reason assigned by the keeper for not obeying his printed instructions was, that he had received verbal instructions from the person sent from the custom-house at New York, not to do so. The lamps are not trimmed during the night, except when compelled to burn bad oil.

The principal keeper does not keep a watch during the night, but divides the four assistants into two watches, two for each tower, and alternating in their duties—the first watch being from the time of lighting until midnight, and the second watch from midnight until daylight. The principal keeper generally retires to bed at nine o'clock, and is only called when something goes wrong.

There are but two spare lamps for these two lights, which are kept in the workshop, at a distance of some forty yards from the towers. There is no spare lamp, filled and ready for immediate use. The keeper thinks he could replace a lamp, in the event of an accident, in half an hour. In all other countries where lens lights are employed, a spare lamp is kept always at hand in the trimming room, trimmed and filled, requiring only a few minutes to change them, and each light is supplied with two spare lamps.

These lights have never gone out at night, so far as the present keeper knows; nor has he found any difficulty in keeping the lights burning.

The lanterns of these towers (more especially that of the revolving light) are too contracted to allow the attendants upon the lights to perform their duties to advantage. Several panes of glass were found broken, and the keeper was without the means of replacing them.

The establishment was found to be in tolerably good order, having been very recently painted in every part, including the steps and floors. The interior of the dome of the lantern is painted red, instead of white.

The two towers are very badly constructed of rubble stone, and their present condition is very bad, owing to leaks and cracks. There is no cellar for oil, nor storerooms in the towers for wicks, chimneys, cleaning-cloths, &c. The oil is kept on the ground-floor of the towers, where the temperature is necessarily very variable.

The annual consumption of oil, of these two lights, is nine hundred and thirty-six gallons; equal to about the consumption of one light, fitted with parabolic reflectors, and twenty-four lamps—the nearest approximation that can be made, in point of useful and economical effect, brilliancy, and power, to the revolving light. The winter oil is generally bad, but sometimes is good. The person charged with the delivery of oil, and other light-house supplies, uses his own pleasure and discretion in delivering the articles, as regards quality and quantity, requiring the
keeper to sign receipts made out by himself. The keeper has never used winter oil in the summer, but is satisfied that the winter oil makes the better light, when of good quality, from the wicks being less charred when that oil is used.

The chimneys to the carcel lamps are not of proper size and shape. The ventilation holes in the lanterns are fitted in a manner not calculated to fulfil perfectly their object. The door of the light-room is required to be left open in the winter, the smoke from the stove being insufferable when it is shut; which has a deleterious effect upon the flame of the lamp. There are no proper means employed for warming the oil in cold weather.

There is no alarm fitted to the lamp, to apprise the keeper of any accident or obstruction to the proper flow of oil to the wick—a most necessary appendage, even when the attendant keeper is always in the tower.

No journal, or daily expenditure of oil and other supplies, nor is there a meteorological or other book, kept.

The dwellings and out-buildings are all out of order, and require repairs.

The lights on Navesink were compared with the Sandy Hook light, and with each other, from the deck of the light-vessel, moored at a distance of six to seven miles from the two stations. In making these comparisons, colored glasses of different shades were used, besides ship’s glasses, to aid the eye in judging of the relative powers of the lights; while the two lens lights were found to be greatly superior in brilliancy to the Sandy Hook light, it was equally apparent that the second-order revolving light was more brilliant than the first-order fixed one. The Sandy Hook light, fitted with eighteen twenty-one-inch reflectors, was decided to be nearly equal in intensity, when one and a quarter mile (estimated) from East Beacon, to the revolving Navesink light; making the distance from the observer to the Sandy Hook light two and a quarter miles, and the Navesink light five and seven-eighth miles; at the same time, the Sandy Hook light was orange color, and the Navesink lens lights white. That is to say, the relative useful effect of the Navesink and Sandy Hook lights is in the proportion of 5.2 to 1; or, the Navesink lights are 5.2 more powerful and effective than the Sandy Hook light. The economical effect cannot be stated with so much accuracy, in consequence of there being two lights at Navesink of different orders.

The estimated consumption of oil of the first-order lens, is 570 gallons. Do. of the second-order lens, is ......................... 384 "

Total, per annum ................................................. 954 "
Reported consumption, including oil required in the dwell-
ing of the keeper and assistants ............................ 936 "

The estimated annual consumption of oil in the Sandy Hook light, is ................................................. 720 "
Reported consumption ............................................. 661 "
Taking the consumption of the smaller lens, which was shown to be more brilliant than the first-order fixed lens, and we shall have the economical effect in the proportion of 1.72 to 1; or, the reflector light is one and three-quarter times more expensive, for oil alone, than the lens light.

The equality in point of brilliancy of the Sandy Hook light (which is not inferior to any reflector light on the coast) and the Navesink lens light, at the respective distances of two and a quarter miles from Sandy Hook, and five and seven-eighth miles from Navesink, furnishes an unanswerable argument in favor of the lens system, independently of the great economy of oil, wicks, &c., in the use of the lens, when properly kept.

There are too many keepers allowed to these two towers—one principal and four assistants! Taking into consideration the contiguity of the two towers, one principal and two assistants ought to be sufficient to perform all the duties properly and efficiently.

In that case the three keepers should be required to take regular alternate watches, changing them every night; making but four hours per night for each keeper, who could visit each lantern by turns, and perform all the duties of the light-room with ease, and be ready in the morning to assist in cleaning the apparatus, and keep the lantern-panes of glass, during snow, sleet, rain, &c., clean and dry. Should it be deemed necessary, however, to have more keepers than three, four, including the principal one, would be a large number for the amount of labor required to be performed.

Under no circumstances should the principal or any other keeper be exempted from keeping a regular watch; and under no circumstances, except in the event of there being only three keepers for the two contiguous towers, should the lantern be left without a keeper from the time of lighting in the evening to extinguishing in the morning.

The authority to remove and appoint assistant keepers should not rest with the principal, but with those who would have every inducement to select the best and most capable persons.

Neither keepers nor assistants should be appointed to fill so important a trust without previous instruction in the duties, and having shown themselves, by a rigid examination, in other respects well qualified for the trust. While the assistants should be under the orders and direction of the keeper, they should not hold their offices at his mere will, but upon the decision of proper persons, after fair examination into complaints of incompetency or malpractices, made of them by the principal keeper. The principal keeper, being held responsible for the faithful performance of the duties, the care and responsibility of all supplies, and the general charge of the establishment, should have under his control, assistants who are not only disposed to perform the duties faithfully, but be in every respect qualified to execute his orders, under the instructions from the Treasury Department. To leave the appointment and dismissal of assistants wholly in his hands, might, and doubtless would in some cases, be productive of injury to the service, and if not entirely, to some extent, defeat the wise and beneficent objects of establishing and keeping up at great expense these essential means of saving human life and the property of our citizens.
The burners to the mechanical lamps belonging to these lights are made of tin, and require to be repaired about once in three months. A burner tipped with silver, which would more effectually resist the action of the great heat evolved, would prove to be much more economical, and insure a more certain and steady light.

The principal keeper to these lights received the board very civilly, and answered all the questions propounded to him promptly; evinced a great desire to gain information relating to his duties, but seemed to regret that he had not had the means of acquiring the necessary information. Under these disadvantages, he deserves great credit for keeping so good a light as he does.

_Sankaty Head light, Island of Nantucket._

This is a second-order, movable (flashes in one and a half and three minutes, according to the printed list) lens or Fresnel light. The apparatus is octagonal, placed in a lantern of iron on a cast-iron pedestal, about fifty-seven feet from the surface of the ground to the focal plane. This apparatus was constructed in Paris by M. Henry Lepautre, under the direction of Mr. Isherwood, in conformity to the fifth section of the act of Congress, approved August 14, 1848, making appropriations for light-houses, &c., which provided six thousand dollars "to purchase lenses, and to fit up, under the direction of the Secretary of the Treasury, a light-house, to make trial of Mr. Isherwood's plan of discriminating one light from another, and of determining the distance of a vessel from a light."

The tower is placed on an elevated point of the Island of Nantucket, known as _Sankaty Head_, the appropriation for which having been made by the act of Congress approved August 14, 1848, upon the recommendation of the Superintendent of the Coast Survey, based upon the then recent discovery of new shoals by Lieutenant Commanding Charles H. Davis, United States Navy, and his report of November, 1847, strongly recommending it both for the general as well as local wants of navigation. It is justly esteemed by those navigating around and about the Nantucket shoals, and by those making European voyages, as one of the most important aids to navigation on the coast of the United States.

This apparatus differs from other lenses of the same order, in being divided in its focal plane by a metallic frame, for the alleged purpose of enabling the designer to transmit, at will, the rays of light emitted, to any desired angle, either below or above the horizontal plane. At the time the board visited the light, the experiment was not undergoing test; but so far as observation allowed them to decide, it was adjusted to transmit to the horizon of its greatest range all the rays of light of which it is capable.

Notwithstanding the division by the metallic frame in the focal plane, this lens is acknowledged universally, so far as could be ascertained, to be, if not the best light in point of brilliancy and power, greatly superior to all others (except, perhaps, those on the Highlands of Navesink, New Jersey,) on the entire coast of the United States.

The present principal light-keeper in charge of this establishment is
a most respectable and intelligent retired sea captain, who commanded
a merchant ship for twenty-five years, and who knows the importance
of his trust, and evinces a most praiseworthy interest in the performance
of all his duties.

He is assisted by two persons, who, for want of quarters at the light-
house, are compelled to reside at some distance from it, to the detriment
of the service.

The present keeper took charge of the light on the night it was first
lighted, (February 1, 1850,) without previous knowledge or instruction
as to its management, but encountered no other difficulty in managing
the mechanical or Carcel lamp than that arising from the use of bad oil,
which he has frequently had.

A regular account of the oil consumed each night is kept. There is
but one spare lamp, which is always kept filled and trimmed ready for
use in the light-room, and which, in the event of an accident to the
other, could be put in place and lighted in fifteen minutes' time.

There are three spare burners kept ready to supply the place of those
requiring repairs.

Extra cords are provided for movable machinery. The lens makes
one entire revolution in eight minutes.

The journal of expenditure of oil shows the following:

Received July 24, 1850............................... 253 gallons "summer oil."
Received July 24, 1850............................... 204 gallons "winter oil."

Total quantity received.................. 457 gallons.
On hand July 1, 1851............................... 87 gallons.

Balance................................. 370 gallons;

being the total quantity consumed from the 24th July, 1850, to July 1,
1851—eleven months and seven days; or 395 gallons consumed per
annum—about the quantity of oil required for a small beacon-light in
any of our rivers and harbors, fitted with ten lamps and reflectors; it
having been satisfactorily ascertained by Mr. Alan Stevenson, the dis-
tinguished engineer who is charged with the care and management of
the Scotch light-houses, &c., and by others who have devoted their time
and talents to light-house improvements, that forty gallons of oil is the
annual average consumption per lamp with reflectors, when the flame is
kept at its normal height. The estimated consumption in this country
is thirty-five gallons per lamp; but the report to the Secretary of the
Treasury (Ex. Doc. No. 14; December, 1850,) shows that the consump-
tion of oil varies too greatly in different establishments to afford reliable
data from which to determine the average consumption.

The principal light-keeper at this station has no other instructions to
guide him in the performance of his duties than those written out for
him by the officer who superintended the placing of the apparatus. He
has no instructions for the government of his assistants, who consequently
feel independent of him and his orders, which produce difficulties. The
two assistants and the keeper take a regular watch during the night,
relieving each other every four hours. The establishment was found to
be clean, and in every respect in good order.
In other countries a light of this class, placed as it is, would have only one assistant keeper, who, with the principal, would keep a regular watch, alternating each night from sunset to midnight, and from midnight to sunrise; and it is believed that number would suffice for all the wants of the establishment, if placed in the hands of thoroughly instructed and trained keepers.

Seamen in our ships keep watch and watch, besides remaining on deck to perform all the duties at sea during the day, exposed to all the vicissitudes of sea-life; the light-keepers, on the contrary, have very little to do during the day, under a proper system for a fair distribution of labor, and at night are not exposed to the weather, except occasionally to keep the glass of the lanterns free from sleet and snow, or from dampness, which may in a great degree be prevented by keeping the interior of the lantern properly ventilated.

The tower was completed in 1850, having been constructed by contract, under the supervision of the collector at Nantucket. It is well built of hard brick laid in cement, from five feet below the surface of the earth to an elevation of fifty-three feet, to which is added six feet of granite, upon which a lantern, nine feet in elevation, is placed, having a cast-iron spiral staircase and floors.

There seems to be an anomaly in making the foundation of brick, while granite is used in completing the tower to the floor of the lantern.

The interior of the lantern is painted white, but leaks, to the great injury of the apparatus. The astragals are vertical instead of being diagonal, as they should be, with plate-glass, 54 inches by 28 inches, and \( \frac{1}{16} \) of an inch in thickness.

There was a large plate of red glass, which the keeper stated was intended for one side of the octagon, (the remaining seven not having been received,) to show red flashes from the lower portion of the lens, to be seen at a distance not exceeding seven miles. Whether this experiment has been tried, or how far it has been successful, is not known.

The keeper to this light-house is a man of far greater intelligence than the light-keepers generally in this and other countries, but the successful manner in which he has managed it, without previous instruction, goes far to prove the necessity for employing just such persons in all our sea-coast lights.

**Brandywine Shoal light, Delaware bay.**

This is a light-tower, erected upon iron screw piles for a foundation, under the direction and management of Major Hartman Bache, of the corps of United States topographical engineers.

The reports of the chief of the Topographical Bureau will afford all the detailed information in relation to the progress of this difficult undertaking, from its earliest stage to its final successful completion, on one of the most difficult sites that could have been selected.

The tower is illuminated by a beautiful specimen of a third-order larger model lens, or Fresnel apparatus, constructed by M. Henry Lepeute, of Paris, on the most approved plan. The burner is composed of two concentric wicks, the interior one being two inches in diameter. This beautiful specimen of mechanism was found to be in fine order and
well cared for; it was impossible to detect a single scratch or fracture in any part of the apparatus, which is entirely free of imperfect prisms.

The principal keeper, at the time of the visit of the board, took charge of the light on the 28th October, 1850, (the night on which it was first lighted,) without having had the advantage of previous instruction in the management of the Carcel lamp, and found difficulty in keeping a brilliant and powerful light at first, but has none now.

Three persons are allowed to assist the keeper in charge of this establishment, more especially to enable him to communicate by boat with the shore and with the pilot-boats, which frequently approach the light, to aid him in getting provisions, &c. With a proper system of visitation and superintendence, the number of persons attached to this isolated position might be lessened, without detriment to the service; but so long as keepers are compelled to provide themselves with rations for a position so difficult of approach for a great portion of the year as this is, it happening very often that all communication is cut off for weeks at a time from the shore,) it will be necessary to keep a boats’s crew stationed at this light.

The keeper, with his assistants, keeps a regular watch during the night; in addition to which, he repairs the lamps, fits new valves, &c., as required.

The lantern is fitted with thick, clear French plate, glass 30 x 32 inches, and the interior painted white.

Regular reports are made to Major Bache, (who has charge of the work,) of changes in the bottom under the structure, and of the consumption of oil, other supplies, &c.

The consumption of oil has been found, by careful observation, to be an average of 1.19 gill per hour.

This establishment is furnished with all the necessary tools and appliances for repairing the lamps, a barometer and thermometer, a clock, water-filter, and medicine chest.

A meteorological journal is kept.

A fog-bell weighing 500 pounds, with a hammer of 14 pounds, is attached to this light, which is struck by a clock-work movement. The bell in foggy weather is struck seven times in thirty seconds, then an interval of thirty seconds before it is struck again; which serves as an admirable means of distinction, in a vicinity where there are other fog-bells.

This establishment has been fitted up with the greatest care, and contains every conceivable requisite, embracing a water-tank of iron, capable of holding 1,050 gallons, ten casks holding twenty gallons, and three of thirty-three gallons each; five berths for the keeper and assistants, coal-bunker, and store-rooms, &c., very complete.

There are three large oil-tanks, constructed of heavy block-tin, well painted and in good order.

Much ingenuity is displayed in fitting the purchase for hoisting the boat up to the davits.

The keeper of this light deserves great praise for the manner in which he keeps it; especially when it is remembered, that at the time of his taking charge of it he never saw a mechanical lamp.
The board having made a careful personal inspection of this work, which is not only novel, but bears the strongest evidence in itself of the great difficulties which attended its erection, proceeded towards the capes for the purpose of comparing the relative brilliancy and range of the different lights in sight.

The following are the results:

Brandywine shoal, third-order larger model lens light, 45 feet above the level of the sea; bearing per compass NW. by N.; distant 15 miles.

Cape May, revolving reflector light, fitted with fifteen sixteen-inch reflectors and lamps; elevated about 75 feet above the level of the sea; bearing N. $\frac{3}{4}$ E.; distant $8\frac{3}{4}$ miles.

Cape Henlopen, fixed reflector light, fitted with 18 twenty-one inch reflectors and lamps; tower 72 feet, (estimated;) height of base 20 to 25 feet; 92 to 97 feet above the level of the sea; bearing W. by S. $\frac{1}{3}$ S.; distant $6\frac{1}{4}$ miles.

These distances are found by applying the bearings on the coast survey chart of Delaware bay.

These three lights having been watched by the members of the board in running down the bay until they reached the point from which the relative brilliancy of the three lights could be determined by the aid of colored and ship's glasses, they came to the conclusion, without difficulty, that the third-order lens light on the Brandywine shoal, with an elevation of only forty-five feet, was more brilliant at the distance of fifteen miles (nearly its greatest range) than either the fixed light of the first class of reflector lights on our coast at the distance of six and one-fourth miles, or the revolving reflector light at Cape May, intended to be a first-class sea-coast light, at the distance of eight and three-fourth miles.

The comparison was continued from this point to the Delaware breakwater, and after anchoring under it; which confirmed previous conclusions.

That is to say: the Brandywine light, a third order large model lens or Fresnel apparatus, is, in brilliancy and useful effect, five and three-fourth times better than the Cape Henlopen light, fitted with eighteen twenty-one inch reflectors and Argand lamps, and three times better than the Cape May revolving light, fitted with fifteen reflectors and Argand lamps. The economical effect being in the proportion of 1 to 3.93 with Henlopen, and 1 to 3.22 with Cape May; or, Cape Henlopen expends 3.93 times more oil than Brandywine light, and Cape May expends 3.22 times more than the Brandywine light, per annum.

In addition to the saving of oil, it is believed the saving of wicks and chimneys will be found in practice, in the proportion of one to eighteen at Cape Henlopen, and one to fifteen at Cape May, and cleaning-cloths, buff-skins, powders, &c., in the same proportion.

It cannot be urged, in this instance, that more keepers are required for the Brandywine light, with the lens apparatus, than if it were fitted with reflectors, insasmuch as a boat's crew would be necessary in either case, under the present arrangements in regard to subsistence of keepers, and to make the Capes Henlopen and May lights equal in usefulness to what they might be, even with the present apparatus, there
should be two keepers to each of them, to be on watch and watch in
the light-rooms during the entire night, which would remove one of the
objections which has been urged against the employment of the lens on
our coast.

It may be remarked, that the only three stations at which lens lights
have been placed, Congress passed special laws providing them; while
England, Scotland, Ireland, and the continental maritime States of
Europe generally, have, during the last fifteen years, adopted the
French system of illumination as rapidly as renovations could be with
propriety made, and new necessary lights could be established.

2.—CATOPTRIC OR REFLECTOR LIGHTS OF THE UNITED STATES, VISITED
BY THE LIGHT-HOUSE BOARD.

Sandy Hook main and beacon-lights, New Jersey.

The first reflector lights visited by the Light-house Board were those
at Sandy Hook, and in the vicinity embracing those in New York and
Princess bays.

The Sandy Hook main light, and the two beacons adjacent, serve as
the principal guide to pilots and navigators in passing over the bar, and
through the channels leading from sea to New York bay.

The tower of Sandy Hook main light was constructed in 1762, under
royal charter, of rubble stone, and is now in a good state of preserva-
tion. Neither leaks nor cracks were observed in it. The mortar ap-
ppeared to be good, and it was stated that the annual repairs upon this
tower amount to a smaller sum than in the towers of any of the minor
lights in the New York district.

The dwelling attached to this tower had just undergone a thorough
repair, and was painted in every visible interior part, where paint could
be put on—ceilings, floors, walls, and the steps of the tower, from the
oil-room on the ground floor to the lantern. The painting had the ap-
ppearance of having been done in great haste, and was undoubtedly put
on in unnecessary places. The dwelling was not clean, notwithstanding
the recent painting and repairs.

The inside walls of the tower had been recently—but two years had
elapsed since the outside had been—whitewashed.

The illuminating apparatus is composed of 18 21-inch reflectors, and
Argand lamps, which were fitted new, according to the best information
on the subject, in 1842.

The reflectors were, in many cases, out of adjustment; they were not
bright, and were scratched in cleaning.

The fountains and burners of the lamps were of an old pattern, and
not clean. The holders for the glass chimneys were loose and badly
fitted.

The keeper is not instructed in the manner of adjusting the appa-
tratus, and had entered upon his duties without previous instruction.

The lantern is constructed of iron, glazed with plate glass, 24 × 24
inches; the astragals large, and placed vertically instead of diagonally,
as they should be; the interior of the dome, although reported to have
been painted white only four weeks previous to the visit of the board, was dirty and black, from the accumulation of soot, attributable to bad combustion, arising from imperfect ventilation. *The ventilators are permanently closed, and never used*; the trap-door, used for ingress and egress, is the only means employed for ventilating the lantern while the lamps are burning.

There is but one keeper allowed to this station, composed of the main and two beacon-lights, at the distance of about one mile the one from the other, containing 32 lamps and reflectors.

To perform the duty of lighting and extinguishing the 32 lamps at this station properly, it would require the keeper to walk about three miles, morning and evening, to the entire neglect of the lamps first lighted; rendering it utterly impossible to attend properly upon them during the entire night.

The present keeper employs a person (a small increase of salary having been allowed him to enable him to do so) to assist him in the performance of his duties; but the small sum allowed does not enable him to obtain the services of such a person as so responsible and important a trust demands.

The fact that there is only one keeper at Sandy Hook, while there are five at Navesink, cannot fail to be remarked upon.

The lights are not lighted at sunsetting, and kept burning until sunrising, in compliance with instructions. The keeper uses his own discretion in this matter, generally lighting about dusk and extinguishing at daylight.

From the best information the keeper could afford, the annual consumption of oil amounts to about 661 gallons at the main light, containing 18 lamps and reflectors. The keeper stated that the oil last year was bad; the winter oil was cut, in cold weather, with a knife.

Supplies are furnished once during the year. The person charged with the distribution of supplies, leaves the articles in such quantities, and of such qualities, as he pleases. Bad articles are consumed, as a matter of necessity.

The Sandy Hook lights are not trimmed during the night; in the keeper's opinion, they do not require it.

The apparatus is repaired by the person charged with the delivery of supplies, once during the year, and he alone decides what is necessary to be done, without reference to the wishes or opinions of the keeper.

No journals of expenditures, or weather, are kept.

He has no orders to report upon the lights which ought to be seen from this light. There are no means at the keeper's command for rendering assistance to the shipwrecked.

Quarterly returns are made to the collector at New York, of the oil, &c., consumed, which amount is arrived at by deducting the quantity on hand, as near as can be ascertained, from the annual quantity received, and not by keeping a daily account of the expenditures.

There is no timepiece, barometer, or thermometer, allowed to this station.

The light-vessel, which is anchored six or seven miles from the light-
house, is seldom seen at night from the lantern of the main light. It is sometimes seen by the aid of a ship's glass.

Neither oil-cellars, nor store-rooms, are provided for this light-station. The oil is kept on the ground or lower floors of the light-towers, subjected to the great variations of temperature of places near the ground.

The glass chimneys, wicks, polishing powder, cleaning-skins, trimming scissors, cleaning-rags, &c., which ought to be kept free from dust, sand, &c., have no appropriate places set apart for them. These articles, with the spare lamps and burners, were thrown together promiscuously, on one side of the floor of the tower, which had been boarded off, and which was very dirty.

The two beacons are wooden structures, on stone foundations. Exteriors recently painted; interiors unfinished, and in bad order. The glass of the lanterns is of a very small size. Each beacon has seven lamps and fourteen-inch reflectors.

The ventilators in the beacons were found to be permanently closed, as in the main light.

The whole establishment was deficient in neatness.

The Sandy Hook main light has had the reputation, for a long time, of being one of the best reflector lights on the coast of the United States. The comparison made between it and the lens lights at Navesink, already given, shows most conclusively how far inferior it is to them in point of brilliancy, range, and economy; although it doubtless subserves all the useful purposes of a local navigation, as a mere harbor or bay light, (while those on Navesink serve as the sea-lights to point out the entrance to New York bay.) This light cannot properly be placed in a higher class, according to the European classification, than a third-order larger model lens, which would consume about one-fourth as much oil, annually, as the present light.

The apparatus at present in the Sandy Hook light is equal to that of any reflector light on the coast, with possibly the exception of the Boston light, fitted with English reflectors, and there are only three or four which can properly rank with it. It is, therefore, beyond a doubt true, that our best reflector lights are not superior to the third-order larger model lens lights.

The distance at which the third-order larger model lens light on the Brandywine screw-pile tower, with an elevation of only 45 feet, and the eye of the observer not more than ten feet from the water-level already stated, proves incontestably that none of our reflector sea-coast lights, with the ordinary elevations of the light-house towers, are superior to it.

The following is a list of the lights examined by the members of the Light-house Board, at each of which, questions were propounded, calculated to elicit all the facts deemed necessary to a fair and correct understanding of the whole mode of management of the light-house establishment of this country.

The answer to the questions were written down, and such notes made upon the spot, as observation warranted:

Navesink, N. J.—two lens lights, first and second-order.
Sandy Hook—one main and two beacon lights; reflector.
Princess Bay light—reflector.

39 L H P
Fort Tompkins light—reflector.
Robbin’s Reef light—reflector.
Sandy Hook light-boat—solid wick; compass lamp.
Lazaretto light—Baltimore harbor light.
Bodkin Point light—bay light; reflectors.
North Point—two lights; bay lights; reflectors.
Beavertail light—coast light; reflectors.
Newport light—harbor light; reflectors.
Boston light—bay light; reflectors.
Minot’s Ledge light-vessel—compass lamp; solid wicks.
Isle of Shoals light—coast light; reflectors.
Portsmouth harbor light—reflectors.
Portland light—harbor light; reflectors.
Cape Elizabeth—two lights; coast lights; reflectors.
Ned’s Point light—bay light; reflectors.
Clark’s Point light—bay light; reflectors.
Cape Henry light—coast light; reflectors.
Old Point light—harbor light; reflectors.
Willoughby’s Point light-boat—solid wick; compass lamp.
Coney Island light-boat—solid wick; compass lamp.
Back River light—bay light; reflectors.
New Point Comfort light—bay light; reflectors.
Sankaty Head light—second-order lens; coast light.
Brandywine Shoal light—third-order lens; bay light.
Cape Henlopen light—coast light; reflectors.
Cape Henlopen beacon—beacon or range light; reflectors.
Breakwater light—harbor light; reflectors.
Cape May light—coast light; reflectors.
Bombay Hook light—bay light; reflectors.
Reedy Island light—bay light; gas, and reflectors.
Christiana Creek light—bay light.
Bald Head light—(Cape Fear;) coast light.
Oak Island—two lights; range lights.
Prince’s Creek—two lights; range lights.
Federal Point light—coast light.
Cape Fear River light-boat—solid wick and compass-lamp.

In addition to this, the board had opportunities of seeing, at night, all the lights in Chesapeake bay, Long Island sound, New York and Delaware bays, with the means of comparing one with another, having reference to their relative elevations, ranges, and brilliancy.

Of each of the lights visited by the board, reference to the copious notes taken at the time will show that the Sandy Hook lights are a fair sample of the whole of them. The same defects were observable everywhere; some were in a better, while others were in a worse condition; some exhibited evidences of care on the part of the keepers, and a desire to perform to the best of their ability the duties required of them; others, on the contrary, exhibited a culpable indifference.

In the main the light-keepers manifested a most praiseworthy zeal in seeking for information, which can only be afforded to them through printed instructions, drawn up with care, embracing in the minutest de-
tail all the duties of a keeper, by a corps of competent inspectors, whose visits must be frequent to insure good results.

The illuminating reflector apparatus is different in nearly every light-house which was visited by the board, and in numerous instances they differed materially on the same frame. The majority of these were spherical, and not parabolic, in shape.

The lamps are, with few exceptions, roughly and badly made; they leak badly, in many instances, without the keepers having the means to remedy it, as the repairs are only made once a year.

The burners and chimney holders are of the rudest description. In some instances the upper portion of the burner is made of iron, and so constructed that it can be taken off; when in use it rests against other metal below, which produces galvanic action, and rapid deterioration ensues. The intensity of the flame is greatly diminished by the burners being of thick, heavy metal, instead of tin; and it is believed that they require repairs quite as often, if not oftener, than those properly made of tin. There is no doubt that those burners of tin, tipped with silver, the better to withstand the great amount of heat evolved, and in general use in the few remaining reflector lights now in Scotland, are much more economical in the end than the heavy and improperly constructed ones in the lights of this country.

The reflectors are imperfect in shape, in material, and in general a want of proper adjustment to project the rays of emitted light to the best advantage, to the horizon.

There does not seem to have been a proper regard paid to the size and shape of reflectors, with reference to the required divergency. Many of the light-houses visited had been very recently refitted with small spherical reflectors; in some of which, the silver had been so badly put on the copper, that it had raised in blisters and peeled off. The reflectors were very thin in many instances.

The lamps and reflectors are, generally, badly placed on the circular iron frames—placed in the centre of the lanterns—and they are, without exception, too far apart to produce a concentrated and brilliant beam of light. Their attachments are very often of the rudest kind, and very liable to be put out of adjustment, for the want of knowledge on the part of the keepers. For the purpose of either increasing or diminishing the flow of oil from the fountains, "tilting" is resorted to; thereby throwing the flames out of the foci of the reflectors. One of the most delicate and important duties of the scientific lamp designer, is to ascertain the proper point for cutting off the oil, to insure a perfect flow, with proper ventilation, at all times, which is never lost sight of by the engineers of the European lights.

The glass chimneys are irregular in shape, size, and thickness, rendering combustion imperfect in most of the lamps, and a great liability to breakage from the unequal heating of the irregular thickness of the glass. A very prominent defect in all the glass chimneys is the length. All of them should be from one-third to one-half longer, and made after a model which experience has demonstrated to be the best to insure the most perfect combustion, and affording the greatest possible amount of light from an Argand burner. The representations of the keepers, and
the large number of chimneys broken, attest the correctness of these conclusions. A comparison of the chimneys sent from Paris by M. Reynaud, and of those generally in domestic use, with those in use in our light-houses, will confirm this statement.

The keepers, not having been instructed to do so, seldom clean the interior of the burner, which renders the Argand lamp and burner but little better than the exploded solid wick lamp, which is fed with the single current of external air. Many keepers, from (as they say) notions of economy, use broken chimneys, which greatly impairs the intensity of the lights.

The interiors of the lanterns are generally dirty, and many are painted black; the astragals are large and vertical, and the glazing badly executed with putty; a large portion of the light which ought to be transmitted to the horizon is consequently absorbed or intercepted.

In some lights a very small amount of oil is consumed per lamp, producing, necessarily, a bad light, which is false economy when the purpose of the light is taken into consideration.

The supplies in general are bad in quality, and, in many instances, insufficient in quantity.

The material furnished for cleaning the reflectors is unfit for that purpose. It is used for polishing copper and brass by those who know its properties; but it is never used for silver. Whiting and rouge of the best quality are used in light-houses in other countries, for that purpose. The deleterious effects of the "tripoli" was seen on reflectors which had only been in use a few weeks. It would be impossible to keep reflectors in proper order with the cleaning materials furnished to the keepers. This was so apparent to many of the keepers—especially to those who had had some experience in light-keeping—that they preferred to purchase whiting from their own small means, to using a powder which would, in a short time, render the reflectors almost useless as a means of increasing the intensity of the light.

Few keepers give their entire attention to the lights under their charge; many follow other vocations, which require them to be absent for days at a time from the lights, leaving them to be attended to by some incompetent member of the family, or perhaps, as there are numerous instances, by servants.

The present system of management, superintendence, and inspection, has been productive of evils which are becoming greater, daily, and which can only be arrested by a radical change. The most important article of supply, oil, is delivered with the other articles, and in the same manner. The oil tested at various light-houses by the oiliometer, was, in every instance, below the standard. In one or two instances it was only two to three degrees below it; but in some as great as seven to ten degrees. The keepers, with few exceptions, had had bad oil, and they stated in all such cases that they were compelled to burn it.

The wicks are not of a uniform texture or closeness. Some are of a fair quality; but others were not such as the service demands, to produce good lights.

There were but two pair of trimming scissors found in all the lights
visited by the board; scissors of the most common description were found at all the other lights. It is needless to add, that a lamp cannot be properly trimmed without trimming scissors.

FLOATING LIGHTS OF THE UNITED STATES.

The floating lights of the United States, visited by the board, were not such as the interests of commerce demand.

The light-vessel off Sandy Hook, of 280 tons, is well provided with boats, moorings, &c., and everything was found to be in good order. There are two lanterns, with fourteen round and two flat wicks, through the top of a covered bowl. There were no Argand burners nor reflectors.

The consumption of oil was reported to be three hundred and sixty-five gallons per annum. The light is of very little use with the present illuminating apparatus, as it cannot be seen further than three to seven miles, and then very dimly. The vessel was reported to be very old, and unsuited to the exposed position off Sandy Hook. The vessel, from peculiarity of model, was represented to roll very heavily, and to be very uncomfortable in bad weather. The master of the light-vessel did not consider it safe to be in so exposed a position in that vessel, in bad weather, (vide appendix D.)

The other floating lights visited were found to be in bad order, badly attended, and all with the inefficient illuminating apparatus already described. These vessels were in two instances found nearly deserted; in one, both the master and mate were absent, and in the other there was no one aboard but a black boy, supposed to be about twelve or thirteen years old, and the vessel in very bad condition. Nothing could be much worse than the floating lights of the United States. The want of care and attention in wetting the decks and keeping them clean, scrubbing the vessels outside, and keeping them properly painted and well ventilated, will account for the rapid decay of them, especially in warm climates.

Many of them are not moored, but anchored by a single chain and anchor, with a long scope of cable; the vessel consequently describes a large circle around the anchor, destroying, in some degree, her usefulness as a range, and is in danger of fouling the anchor in swinging.

The queries addressed to nautical men were answered by civilians and naval officers commanding United States mail steamers, civilians commanding packets and other sailing ships, and passenger sea steamers, or such as have been in such important positions, and by naval officers on coast-survey service. The chief results of these inquiries may be thus stated:

1. That the Navesink and Sankaty Head lens lights are far superior to all other lights on the coasts of the United States.

2. That the lights of Great Britain, France, and of maritime Europe, and their dependencies in general, are superior to those of the United States.

3. That the English lights (reflector and lens apparatus) on the Bahama banks, and the lens lights at Havana and Cape San Antonio, (Cuba,) are greatly superior to those on the coast of the United States.
4. That the floating-lights of the United States are far inferior to those of England and Ireland in brilliancy, range, useful effect, and certainty of being found at all times in their proper positions.

5. That the lights and other aids to navigation in the United States compare unfavorably with those of Europe and the West Indies.

6. That the buoys, beacons, and sea-marks of the United States do not fulfil all the wants of commerce and navigation.

7. That the buoys are in general too small, and not properly painted and marked, to be distinguished at sufficiently great distances.

8. That lights are not sufficiently well distinguished, and the towers are too much alike to be readily known by day.

9. That sufficient care and attention is not paid to mooring and placing light-vessels and buoys; that changes of location and of distinctions of light, removal of vessels from their positions, extinguishment or lighting of lights, changes in location, color, and shape of buoys and sea-marks, are made without giving sufficient notice through the medium of the most widely circulated commercial newspapers, and by posting notices (printed in large type) at the custom-houses of this and other countries.

10. That proper facilities are not afforded the seafaring community for making known its wants, and for pointing out cases of neglect of light-keepers and others connected with the establishment; as in France, for example, where, at the different custom-houses, a book is kept, and the masters of vessels, and others interested in commerce and navigation, are invited and expected to register all complaints or suggestions, for the benefit of the light-house engineers.

11. That the lights of the United States are not lighted at sunset, and extinguished at sunrise, with the punctuality and regularity which this important service demands; and that the lights, from neglect, become dim or less bright, during the later hours of the night and early hours of the morning, than they are when first lighted.

12. That many very important points on the coast of the United States require additional aids to navigation, to render it safer, more certain, and lessen the present large annual loss of human life and property by shipwreck.

Among the most prominent of the proposed aids may be named:

1. A light-vessel of the first class, to be fitted with the best reflector apparatus, for the South shoals off Nantucket.

2. A light of 150 feet elevation above the sea-level, fitted with a first-order lens apparatus of a suitable distinction, with reference to the one at Montauk point and at Fire Island inlet, be placed half-way (in the vicinity of West bay, (Long island,) between Montauk and Fire Island lights.

3. A first-class light-vessel, fitted similarly to the one proposed for Nantucket shoals, to be moored on the outer or seaward end of Frying-pan shoals, (Cape Fear,) and to be kept in that position until a sufficiently elevated and powerful light is placed on Cape Fear; to be seen, under ordinarily favorable circumstances, outside of these dangerous shoals, lying in the track of sailing vessels bound from the Gulf of Mexico to our northern ports, and of those bound to our southern ports.
north of Cape Florida, from Europe, the British North American possessions, and from our own ports; and of all steamers to and from the north, to the Gulf of Mexico, island of Cuba, Chagres, &c.

4. A first-order lens light, with an elevation of 150 feet, half-way between Cape Henry and Body’s Island light.

5. A first-order lens light, with an elevation of 150 feet, near Jupiter inlet, Florida.

6. A first-order lens light, with an elevation of 150 feet, near Hillsborough inlet, Florida.

7. A first-order lens light, with an elevation of 150 feet, half-way between the two towers now in the course of erection at Carysfort reef and Sand key, Florida.

Second only in importance to the foregoing proposed new structures is the necessity for substituting first-order lens apparatus in place of the present inferior reflectors, and giving to each tower an elevation of not less than 150 feet, at the following points, where first-class sea-coast lights are indispensable to the safety of commerce, viz: Gay Head, Montauk point, Fire Island inlet, Barnegat, Cape May, Cape Henlopen, Assateague, Smith’s island, (Cape Charles,) Cape Henry, Cape Hatteras, Cape Lookout, Cape Fear, Cape Romain, Charleston, Cape Canaveral, Tybee, Cape Florida, Dry Tortugas, Sand island, (near Mobile point,) Pensacola, and the two principal passes at the mouths of the Mississippi.

13. That the lights along the southern coast from Navesink are greatly inferior to the lights further east, and are, in their present condition, of very little use to the mariner.

14. That the proposed additional lights for the Florida coast should have such elevations and illuminating apparatus as will insure a range that will bring two lights in sight when midway between them.

15. The questions addressed to the general superintendent of lights, &c., and local superintendents, master of the vessel employed to distribute supplies, the collector of the port of Boston, by whom the oil and other annual supplies, apparatus, &c., are purchased, are given, with the replies, (omitting only the portions containing reflections on individuals, which the board do not deem it proper to admit into this report.)

The facts obtained from these papers will be stated under the different heads of the report.

The following extracts and abstracts from the letters of the general superintendent of lights, will give a general idea of the present system:

The law of August 7, 1789, authorized the Secretary of the Treasury "to rebuild when necessary, and keep in good repair, the light-houses, beacons, buoys, and public piers in the United States, and to furnish the same with all necessary supplies;" the management of the establishment was then placed under the commissioner of the revenue, and in 1821 under the present general superintendent of lights, &c.

The Secretary of the Treasury is also authorized to "agree for the salaries, wages, or hire of the person or persons appointed by the President for the superintendence of the same."

The collectors most convenient to the lights, without regard to their collection districts, were appointed, first by the President, and afterwards by the Secretary of the Treasury, as superintendents of lights, &c.,
to act under the general superintendents at the seat of government. These local superintendents, under the law of May 23, 1828, receive a commission of 2 1/2 per cent. on their disbursements, limited, however, to $400 per annum.

Sites for authorized light-houses were selected by these local superintendents, assisted by retired pilots and ship captains, under the direction of the general superintendent. The contracts were made by the local superintendents, who appointed mechanics as overseers of the work. The local superintendents are directed to visit all the lights in their districts once a year, and report their condition, and the conduct of the keepers, to the general superintendent.

The towers are of four different elevations—65, 50, 40, and 30 feet. The illuminating apparatus is not made and fitted under the direction of a competent engineer, but by a custom-house officer, and a mechanic.

"I have had much inconvenience and difficulty to encounter from the frequent changes incidental to our form of government, in the light-house keepers, who for a time do not understand the management of their lamps, and consequently keep bad lights and waste much oil."

"So necessary is it that the lights should be in the hands of experienced keepers, that I have, in order to effect that object as far as possible, recommended, on the death of a keeper, that his widow, if steady and respectable, should be appointed to succeed him."

* * * * *

"The keepers are not instructed previously to entering upon their duties;" "the trimming and cleaning of a small Argand fountain lamp being so simple and self-evident as to be safely left to the intelligence of the meanest capacity."

"All the oil, tube-glasses, wicks, buff-skins, tripoli, lamps, and reflectors, and parts of lamps and oil-butts, are procured twice a year by the collector at Boston, by advertisement, and forwarded to the light-houses on the Atlantic coast, formerly by one vessel, but now by two vessels; beginning in the spring at St. Mary's, in Georgia, and going eastward to Passamaquoddy."

"A lamp-maker is taken on board for the purpose of repairing the lamps, for which he has the necessary material with him." "In the fall of the year the supplies, procured in the same manner, are sent south from St. Mary's."

Oil, &c., for the lakes, is sent to Buffalo, and other points in the vicinity.

Two kinds of oil are used, "winter and summer" strained sperm oil.

"The buoys established by law are very numerous, and on many points of the coast are attended and kept in their places with great difficulty, and at considerable expense."

"There are four gas-lights, which, in consequence of the keepers not giving timely notice of the necessity for new furnaces and retorts, would be extinguished three to six months in the year, if oil-lamps were not kept at them."

"There is no formal classification of lights."

"As there is no formal classification of the lights, the number classed as first class, or order, cannot be given;" "but in what may be consid-
ered first-order lights, except the lens lights" (three—two of the second order and one of the second order) "the diameter of the burners is three-quarters of an inch; the diameter of the reflector is 21 inches." (Thirty in all, according to the latest list, and many of them with only nine to twelve lamps, and averaging only thirteen lamps, among which will be found Fort Tompkins bay light, nine lamps; Ocracoke harbor light, ten lamps; and Chandelier island, nine lamps.) * * "The only modes of distinction of first-class lights, are fixed white and revolving white. These are the most efficient, and cheapest."

"There are no reflectors in use of an inferior quality, to my knowledge."

The reflector lamps are Argand, "with three-quarters of an inch diameter burners, made of iron, and not tipped with silver."

"They (the reflectors) will last from ten to twenty-five years, according to their proper use or abuse."

"The illuminating apparatus used in our light-vessels is the compass lamp."

"No Argand burners and lamps are used." "It is simply a reservoir to hold the oil, with a number of wicks placed around the circumference."

"The expense of repairs for the lamps alone has not been kept separately." "There are no special oil-cellar." "The lanterns are constructed of wrought iron; not of bronze."

"The system of ventilation in general use, is by a top ventilator, traversing, of various forms, or Collins's patent, and by side ventilators, (generally closed,) on the base of the lantern or in the lantern doors; but these means are very inferior to what is furnished by the scuttle-door being left open."

"Professor Faraday's ventilating tables are not used, as the open scuttle supplies a power of draught and a quantity of air sufficient for perfect combustion without them." *

The important branch of ventilation in light-house engineering, has received the attention and consideration, and has been experimented practically upon, by the ablest and most scientific persons in Europe; and the results of their labors have greatly contributed to the improvement of the lights, especially in those of France and Great Britain. The ventilator introduced by European light-house engineers is one of the essential parts of all the apparatus constructed, either for home or foreign use.

"There is not what may be called any general system of construction."

"The kind of tower, if for difficult locations, is sometimes made at this office; sometimes by the experienced engineers employed by me for that purpose, and in all cases examined and approved by me."

There is no systematic plan or arrangement, by which repairs are made.

"Light-vessels last from five to ten years, according to latitude and timber. The average annual repairs are very great."

* A due consideration of the facts relating to the motion of air, will show that proper ventilation cannot be had by the means here referred to.
"The buoys are placed by contract with pilots; they are taken up and replaced in the same manner."

For the mode of purchasing and distributing supplies as exhibited by those intrusted with these important duties, the board refers to the letters of the collector of Boston and of Mr. Howland, the person charged with the delivery of supplies.

The general system seems to be, that the coast of the United States is divided into districts, and placed under the superintendence of collectors of the customs, without regard to whose districts the lights may be in.

The local superintendents of lights receive a percentage on all disbursements for repairs, new structures, &c. They are directed to visit each light once a year, and report the condition of them to the general superintendent. This latter duty is also required of the master of the supplying vessel, who delivers oil and other supplies once a year, going south in the winter and north in the summer. Supplies are purchased in Boston, by the collector of that port. The lamps and reflectors are also made and purchased there. Many of the light-houses have been built, indeed nearly all of them, by Boston contractors.

Mechanics are employed to superintend the construction of new buildings, upon whose certificates the amounts of the contracts are paid. The local superintendents recommend, and afterwards order such repairs as the general superintendent may authorize. The certificates of the keepers, in cases of repairs, are generally required and considered satisfactory.

The number of keepers and assistants is only regulated by the appropriations. As a general rule, but one keeper is appointed to a light-house, but in some cases an assistant is allowed; and in others, an increase of salary is given as a reward for extra services.

The general superintendent under the law of 1789, under which the present light-house establishment has grown up, has authority to introduce any apparatus, make renovations, remove or rebuild towers, replace buoys, &c., at his pleasure. The law which permits the purchase of new lanterns, plate glass, new lamps and reflectors, movable machinery, &c., will equally permit the purchase of lenses for towers, and parabolic reflectors and Argand lamps, for light-vessels.

The law appropriating annually large sums for the maintenance, repair, and renovation of light-houses and light-vessels, does not prescribe what towers, vessels, or apparatus are to be repaired, nor does it specify what is to be placed in these towers and vessels in place of the old apparatus.

The board collected, also, the reports on the condition of the light-house system of the United States in past years, as assisting in their deductions in reference to the present condition, by showing its antecedents. Extracts from them are given in the appendix, and will be referred to in the course of this report.

The board would here refer specially to the reports of the Hon. John Davis, chairman of the Committee on Commerce in the Senate, recommending the introduction of the lens or Fresnel system of illumination, as being superior to the reflector system followed in this country, and also
recommending a change in the mode of superintending and inspecting the lights; also, to the notes of Commodore Perry, United States Navy. The extracts from the reports of officers of the Navy, detailed in conformity to law, to inspect and report upon lights, &c., on the coast of the United States, will be found to contain information and conclusions which the board has no hesitation in confirming at the present time, and are, therefore, considered well worthy of the attention and consideration of those interested in effecting improvements in this important branch of the public service.

To the report of the Hon. R. J. Walker, Secretary of the Treasury, and the extracts accompanying it, from Senate document No. 488, first session Twenty-ninth Congress, especially the valuable papers from M. Léonor Fresnel, the eminent engineer and secretary to the "Commission des Phares," of France, the board invites particular attention, as containing undoubted facts and deductions relative to the lens system for illuminating light-houses, which the longest practical experience has confirmed in England, Scotland, Ireland, and in general throughout the whole of maritime Europe, and to the correctness of which, experimentalists have everywhere given most willing testimony. The public documents containing facts and opinions furnished by the most eminent seamen in our commercial marine, (masters of our New York and other packet ships, &c.,) by officers of the Navy, engineers of high standing and undoubted ability, and by other disinterested individuals who have given testimony on this most important branch of the public service, are referred to with great confidence by the board.

The light-house system of the United States has grown up from small beginnings—only eight lights in 1789, and fifty-five lights in 1820—to its present enlarged condition of three hundred and thirty-one lights in 1851, and without those helps from organization of which some other countries have had the advantage. Great credit is due to the zeal and faithfulness of the present general superintendent, and to the spirit of economy which he has shown. The systems of lighting, however, which twenty-five years ago were in general use, have gradually given way to more improved ones—more efficient and more economical.

The general condition of our lights is not, in the opinion of the board, such as our commerce now requires, and not such as the improvements of the day can supply.

In considering the condition of the different parts of the system in their order, these facts will strongly appear, viz.: that waste of light, by imperfect apparatus, is waste of oil, and must be paid for in money. The navigator would be more benefited by a few good and reliable lights than by many imperfect ones; indeed, he would prefer no light at all to a bad one.

CLASSIFICATION OF LIGHTS.

A proper classification of lights has many and obvious advantages; in fact, it forms the basis of the arrangement of lights in a system. In England the shore lights are classed as Sea-coast, Secondary, River, and Harbor lights. In France they are divided into six orders,
according to the size of the illuminating apparatus. The name of the
order of the light in the French system suggests its purpose, the range,
the relative brilliancy, the size and character of the parts of the illumin-
ating apparatus, and the particulars of detail.

That our own lights have not been classed will explain the many
anomalies in the number of lamps, the forms of the reflectors, and the
like.

It is an admitted principle, that the degree of divergency given to a
light by a reflector for light-house purposes should depend upon its in-
tended objects, including range, &c., and yet no such principle has been
applied in our light-houses, and a waste of light has been the consequence.
Classification is of little avail without other and more important quali-
ties, but is nevertheless an essential of a system.

The following is an assumed classification of the lights of the United
States, according to their present value and useful effect, as compared
to the lens:

1. One station with a first-order fixed and a second-order revolving
   lens light. This combination renders the light only equal to a second-
   order lens light.

2. One station with a second-order flashing light, (lens.) This light
   is not fully equal to a second-order lens, constructed on the most ap-
   proved plan, in consequence of the loss of light by metal placed in the
   focal plane.

3. One station with a third-order larger model lens light, constructed
   on the most approved plan.

4. One station with a revolving light, twenty-one 21-inch reflectors,
   the nearest approximation to a first-order catoptric light on the coast;
   inferior to a second-order lens light.

5. Three stations with eighteen 21-inch reflectors, (fixed light;) not
   better than second-order catoptric, or third-order dioptic light.

6. One station with thirty 18-inch reflectors, (two lights in one tower,
   not better than second-order catoptric, or third-order lens light, (larger
   model.)

7. Four stations with eighteen 15-inch reflectors; about equal to third-
   order lens light, (larger model.)

8. Two stations with seventeen 21-inch reflectors; about equal to third-
   order lens light, (larger model.)

9. Nine stations, fifteen 21-inch reflectors; not equal to a third-order
   lens light.

10. Eight stations, fourteen 21-inch reflectors; inferior to third-order
    lens light.

11. Fourteen stations, fifteen 15-inch reflectors; inferior to third-order
    lens light.

12. Three stations, sixteen 15-inch reflectors; inferior to third-order
    lens light.

13. Eight stations, fourteen 16-inch reflectors; inferior to third-order
    lens light.

14. Eleven stations, thirteen 14-inch reflectors; inferior to third-order
    lens light.
15. Three stations, twelve 21-inch reflectors; inferior to third-order lens light.
16. One station, twelve 16-inch reflectors; inferior to third-order lens light.
17. Four stations, twelve 15-inch reflectors; inferior to third-order lens light.
18. Three stations, eleven 21-inch reflectors; inferior to third-order lens light.
19. Twelve stations, eleven 16-inch reflectors; inferior to third-order lens light.
20. Nine stations, ten 21-inch reflectors; inferior to third-order lens light.
22. Forty stations, ten 14-inch reflectors; inferior to third-order lens light.
23. Thirty-nine stations, eight 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
24. Twenty-eight stations, eight 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
25. Two stations, eight 16 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
26. Two stations, nine 21 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
27. Eighteen stations, seven 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
28. Fourteen stations, six 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
29. Two stations, two 16 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
30. Eight stations, four 14 and 16-inch reflectors; inferior to fourth-order lens, (larger model.)
31. Fourteen stations, eleven 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
32. Four stations, one 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
33. One station, eight 9 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
34. Eight stations, five 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)
35. Four stations, three 14 and 15-inch reflectors; inferior to fourth-order lens, (larger model.)

RECAPITULATION.

1 tower with 30 lamps; (two lights in one tower.)
1 do.  29' do.
1 do.  21 do.
7 do.  18 do.
2 do.  17 do.
3 towers with 16 lamps.
23 do. 15 do.
16 do. 14 do.
11 do. 13 do.
8 do. 12 do.
29 do. 11 do.
67 do. 10 do.
2 do. 9 do.
70 do. 8 do.
18 do. 7 do.
14 do. 6 do.
13 do. 5 do.
8 do. 4 do.
5 do. 3 do.
2 do. 2 do.
7 do. 1 do.
5 do. small gas lights.
4 do. lens lights.
37 do. 21-inch reflectors.
1 do. 18 do.
41 do. 16 do.
51 do. 15 do.
168 do. 14 do.
1 do. 9 do.
9 towers without reflectors.

*Lens lights.*

One station equal to second-order lens light.
One station not equal to second-order lens light.
One station with third-order (larger model) lens light.

*Reflector lights.*

12 lights not equal to second-order lens light.
61 lights not equal to third-order lens light, (large size.)
35 lights not equal to third-order lens light, (small size.)
121 lights not better than fourth-order lens light.
84 lights inferior to the fifth and sixth-order lens light.

It is apparent from this statement that there is not a first-class light of any description on the whole coast of the United States. The nearest approximations are at the Highlands of Navesink, composed of a first and second-order light, and the revolving reflector light at Mobile point, of 21 reflectors.

The three next in order are Sandy Hook, Cape Henlopen, and Cape Henry, each fitted with 18 twenty-one-inch reflectors, and in towers of a good elevation.

The Boston harbor light, fitted with 14 twenty-one-inch English reflectors, probably now stands next on this list, although the apparatus is much worn, and has not had the care and attention it deserved.
There are 236 fixed lights; 30 revolving lights; 2 fixed and revolving lights; 18 double lights; and 2 triple lights.

Average number of lamps per light-house, in the United States, is now 9\frac{1}{2}.

Average number in England, (general coast,) 18.
Average number in Scotland, (general coast,) 17\frac{1}{4}.
Average number in Ireland, (general coast,) 20.
Average number in Ireland harbor, 7\frac{3}{4}.

The 41 light-vessels of the United States are fitted without lamps, (in the ordinary acceptation of the term,) and without reflectors. The lights are consequently seen at very short distances, and do not fully subserve the objects for which they were authorized by Congress.

Argand lamps, with large parabolic reflectors, are employed in Great Britain in light-vessels.

The Admiralty list of Trinity House lights for 1849, shows that there were at that time seven floating lights fitted with revolving apparatus, belonging to that corporation.

DISTINCTIVE CHARACTERS.

The distinctive characters of the lights of the United States are:
First. Fixed lights.
Second. Revolving lights.
Third. Double lights, or lights in two towers.
Fourth. Lights in three towers.
Fifth. Colored lights.

Distinctions have been employed at ten stations from two fixed lights, and from one fixed and one revolving light; and in three towers with two lights, one above the other. There is but one triple light on the coast of the United States. The beacons for ranges are not, of course, included in these numbers. Double and triple lights are among the most wasteful modes of distinction, and, it may be added, the least effective. Very little attention has been paid to distinguishing lights in the United States. At points along the eastern coast, many fixed lights are seen at the same moment, without the means of knowing any of them. The proportion of revolving to fixed lights on the entire coast, is 1 to 9.2. The proportion of all modes of distinction, including multiple and colored lights, is 1 to 5.2.

On the coast of Maine there are 34 light-stations; of which number, 3 are revolving, 1 two-towers fixed and revolving, 1 two-towers fixed lights, and the remaining 29 are all fixed lights.

In New Hampshire there are 3 light-stations; 1 fixed, 1 revolving red and white and 1 fixed, with two lights in one tower.

In Massachusetts there are 42 light-stations; of which 5 are revolving, 11 fixed and revolving, 1 lens, flashing, 8 double fixed, 1 triple, and the remaining 26 are fixed white lights.

In Rhode Island there are 9 stations; 2 are revolving, and 7 are fixed lights.
In Connecticut there are 11 stations; 2 are revolving, and 9 fixed lights.
In New York there are 41 light-stations; 4 are revolving, and 37 fixed lights.
In New Jersey there are 10 light-stations; 1 revolving, 1 fixed and revolving, 1 red, and 7 fixed lights.
In Pennsylvania there are 4 light-stations, and all fixed lights.
In Delaware there are 8 light-stations, and all the lights are fixed. The one on the breakwater is called a red and white light, by the keeper; but as the light cannot be seen through the dark red shield-like shades, the white part only is seen.
In Maryland there are 14 light-stations; 1 double fixed, and 13 single fixed lights.
In Virginia there are 8 light-stations; 2 are revolving, and 6 are fixed lights.
In North Carolina there are 11 light-stations; 2 are revolving, 2 double fixed lights, and 7 fixed lights.
In South Carolina there are 5 light-stations; 1 revolving, 2 double fixed light beacons, and 2 fixed lights.
In Georgia there are 9 light-stations; 2 revolving, 1 two fixed beacons, and 6 fixed lights.
In Florida there are 12 light-stations; 6 revolving, and 6 fixed; one of the latter with red shades.
In Alabama there are 3 light-stations; 1 revolving, and 2 fixed lights.
In Mississippi there are 4 light-stations, and all fixed lights.
In Louisiana there are 14 light-stations; 3 revolving, 1 with two lights in one tower, 1 red light, and the remaining 9 are all fixed lights.
Of the remaining 49 lights, only two are revolving.
The foregoing lights are exclusive of the 42 light-vessels distributed along the coast, forming an important part of the light system, all of which are fixed lights.
From the Highlands of Navesink to the fixed light on Dry Tortugas, a distance of upwards of 1,300 miles by the coast, there are only three prominent revolving lights; all the rest being single fixed lights. The revolving lights at Cape Charles, at Ocracoke, Sapelo, and Amelia island, are not included in this estimate, because they are minor lights, and not seen, except by vessels bound into ports near their location. Body's Island is so badly placed, and so low, that it is of very little use to navigators.
From Dry Tortugas to Cape Canaveral, a distance of nearly 400 miles, there is not a single revolving or other than fixed lights.
From Charleston to Cape Canaveral, a distance of 300 miles, all the prominent lights are fixed, with only two minor revolving lights.
From Charleston to Navesink, there is but one revolving light which can be of any use to the mariner bound to New York.
In England the lights are distinguished by fixed, revolving, flashing, colored, (red only being used,) with combinations of double fixed, fixed and revolving, &c.
The English Trinity House corporation have 7 revolving lights on board of light-vessels, out of 25; and the proportion of revolving to fixed lights is 1 to 4.2. Of 40 sea-coast lights, 19 are fixed white, 10
The Scotch have 11 fixed white; 2 revolving red and white; 4 revolving, showing brightest every minute; 4 revolving, and showing white lights every two minutes; 2 double fixed lights; 2 flashing once in every five seconds; 4 intermittent lights, brightest state once in two minutes; 2 fixed and red; 1 double, revolving at the same instant; making only 11 fixed lights, out of 33, on the entire coast of Scotland.

In Ireland there are five distinctions employed: fixed white, fixed red, revolving white, revolving red and white, and intermittent lights. Of 23 sea-coast lights, 11 are fixed white, 7 revolving, 1 fixed red, and 1 fixed and revolving.

In France there are nine principal combinations of lights, possessing distinctive characteristics, viz:

1. Flashes which succeed each other every minute
2. Flashes which succeed each other every half minute.
3. flashes alternate red and white.
4. Fixed lights, varied by flashes every four minutes.
5. Fixed lights, varied by flashes every three minutes.
6. Fixed lights, varied by flashes every two minutes.
7. Fixed white lights, varied by red flashes more or less frequently.
8. Fixed lights.
9. Double fixed lights.

To which might be added fixed and revolving, in two towers, as at Navesink. There are, however, very few double lights in France, and are only employed to give a very decided character to a locality, in contradistinction to those nearest.

By adopting the principle of Rear Admiral Rossel, as set forth in the programme reported by him for lighting the coasts of France, in 1822, finally adopted by the French administration in 1825, and which has been steadily adhered to since, of placing first-order sea-coast lights within the distance of forty-two nautical miles of each other, there can be no great difficulty in obtaining a sufficient number of very marked distinctions for sea-coast lights. The present advanced and progressive state of nautical science is also brought in to the aid of the light-house engineer, as it will now seldom happen that a navigator will be eighty-four miles out of his reckoning.

By commencing at one line of the boundary of a country, on a sea-coast where a first-order light is required, with a revolving light; then, at the distance of forty-two nautical miles, a fixed light; and at the distance of forty-two nautical miles further, a flashing light; then an intermittent bright, then a fixed light; then a revolving—and so on along the entire coast—the mariner will find no difficulty in recognizing any well-kept light that he may see. Should it become necessary to employ time as one of the elements, then there can be no better system than that employed in France.

An occasional deviation may be found to be necessary, such as the erection of two towers for fixed, revolving, or fixed and revolving lights.

This is one of the branches of light-house service which can only be
executed properly by competent persons, who have thoroughly inves-
tigated and studied the subject, both in general and for special cases.

Should the very ingenious plan of distinguishing lights by occulta-
tions, as proposed by Mr. Charles Babbage, prove, upon experiment, to
be practicable, the whole system of characteristic distinctions will be
entirely changed and greatly simplified.

The floating lights of the United States are all fixed, and fitted with
common torch lamps, without Argand burners and reflectors.

The light-vessels are too small for exposed positions, and the models
are not the best for the purposes for which they are designed. They
are not provided with moorings such as they require, and there is not
sufficient attention paid to placing them in their proper positions.

The lights, in consequence of the inferior lamps without reflectors, are
of very little use to the navigator. The uncertainty of finding the light-
vessels in their proper positions, by navigators who have been several
months absent from the country, produces a general distrust, which de-
stroys all reliance on them.

The floating lights of England and Ireland are built upon the best
models; are of sufficient tonnage to be safe at the points for which they
were built; are constructed in the most substantial manner—of wood
generally, but in some cases of iron; are moored with heavy anchors
and chains, and long scopes. Those placed to mark channels, as the
northwest light-vessel at Liverpool, are moored with long scopes of cable
to a swivel, and hove in, so that in swinging they do not change their
positions perceptibly. These floating lights are placed in the most ex-
posed positions in the Irish or St. George's channel, in the British chan-
nel, North sea, and in the most exposed positions of the English and
Irish coasts. It very seldom happens that they break from their moor-
ings, and are never taken away without previously placing a duplicate
in the position.

The system of relief to the keepers and crews is an admirable one—
one that insures a faithful performance of the duties entrusted to them,
to the great advantage of navigators.

The English floating lights are fitted with Argand lamps and parabolic
reflectors—fixed, revolving, and double lights. They are distinguished
by day by cages of hoop-iron, balls, cones, flags, &c. The name and
number of each light-vessel are painted in large letters and figures con-
spiciously on the sides and stern.

These lights, from the superior apparatus employed in them, and the
great care and attention of inspections and superintendence, under the
most rigid instructions in detail, (which are printed in large type and
hung in frames in the apartments,) are very little inferior to the same
class of reflector lights, with equal elevations, on shore. Many of them
can be seen from the deck of a merchant vessel twelve to fourteen miles,
while those in this country can only be seen from three to seven miles.

Refractors have been made by Mr. Letourneau, of Paris, for light-
vessels, which cannot fail to be productive of much benefit, and which
are, no doubt, destined to render floating lights much more useful to the
navigator than they have hitherto been, even in England, where the best
reflecting apparatus has been employed for many years.
MODE OF ASCERTAINING PLACES OF LIGHT-HOUSES, &C.

No systematic mode of determining where there should be a light-house, or boat, seems to have been followed for any period of years, and hence the lights are so numerous in some parts of the coast as to be inconvenient, (vide letter of general superintendent of lights,) and on other parts are so few as not to supply, even moderately, the demands of navigation.

The principle adopted by the French commissioner of light-houses for placing lights on the coast of France, will be found stated in another part of this report; steadily adhered to, it has prevented the wasteful multiplication of lights, and has provided, gradually, those really necessary for facilitating navigation.

The law, and the instructions of the Department, call upon the board for a programme for the coast of the United States, "to guide legislation" on this important point.

The act of Congress of March 3, 1851, directs also, "That, if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house, light-boat, beacon or buoy, or to ascertain more fully what the public exigency demands, the Secretary of the Treasury shall, thereupon, direct the superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes."

This proviso insured a report in all doubtful cases. It appears, also, to be the next subject to be considered, viz: "Special selections for sites for light-houses." These were to be selected on surveys made as just stated. In 1851, thirty sites were thus examined and reported upon by the Superintendent of the Coast Survey, on actual examinations and reports made by the hydrographic officers of the work. The expense is stated to have been less than one thousand dollars.—(Report of Superintendent Coast Survey for 1851.) The board recommend a continuance of this system.

PLANS FOR LIGHT-HOUSES, LIGHT-VESSELS, LIGHTING APPARATUS AND ITS ACCESSORIES.

No systematic methods appear to have been resorted to, to secure plans for light-houses, light-boats, lighting apparatus, and other accessories, in the United States. The preparation of plans for light-houses, lighting apparatus and other accessories, is the business of an engineer. Occasionally architects have been consulted, and the Treasury Department and Congress have sometimes devolved the preparation of plans, &c., upon the officers of the corps of topographical engineers. The un-called for variety and the inconvenience and ill-adaptation of the structures visited by the board, show how much the intervention of knowledge is required. In discussing the details of these works, this fact will constantly appear. Professional skill is essential to efficiency and economy. Ill-contrived light-houses require numerous additions, and do not then answer their purpose. Badly constructed ones are expensive in repairs,
besides injuring the apparatus and stores contained in them. Badly-contrived lamps waste the oil, and answer imperfectly the purpose of lighting. Mirrors badly made, unskilfully arranged, unscientific in their forms and adjustments, cause a loss of light which is paid for in oil. Imperfect ventilation causes a bad light. Unscientific arrangements of the lantern in regard to glazing, painting, &c., cause a waste of light. The proper arrangement of these matters is the study and occupation of a profession. The neglect of the proper conditions is wasteful. Plans of light-houses of different classes, with modifications adapted to different localities, would promote economy by the frequent repetition of the same pieces, which in stone-work, brick-work, iron-casting, carpenter's work, glazier's work, and the like, is productive always of a decided economy.

The important subject of alarm-signals has not received the attention which it deserves. In the English light-houses the gong is used instead of the bell, to give signals in case of fogs, and no attempt appears to have been made in this country to compare the value of the two kinds of alarm-signals. The fog-whistle, introduced by Mr. Daboll and recommended by the board, has been found to be far more efficient than the bell.

The board had ample means of forming correct conclusions as to the relative merits of the two modes of warning the mariner in fogs, and found no difficulty in deciding in favor of the whistle, for positions where it can be put up. (See plates.)

Mr. Alexander Gordon, civil engineer of London, proposed to the select committee of the House of Commons on light-houses, in 1845, that the gong employed on board of light-vessels should be superseded by the use of a shrill scream or whistle, such as the railway whistle, giving it sound by a bellows, and having the sound directed around the horizon by reflectors, similar to those of Bordier Marcet for reflecting light. (See plates.) The reflection of the sound of the air-whistle of Mr. Daboll is believed to be practicable by the means suggested by Mr. Gordon; at any rate, the importance of the subject warrants the small expenditure which would be required to test it experimentally.

The discharge of heavy guns has been recommended, and would be effective if there were sufficient force at the light-houses to load and fire them. They would always be expensive, however, every discharge of a twenty-four pounder gun costing about one dollar.

The fog-bells examined by the board were not placed so as to produce the best effect. That at Boston harbor was enclosed in a frame building, the sides of which effectually deadened the sound in two directions.

It is time that this subject received full and careful investigation by experiments under the direction of scientific men. Besides this class of signals, those intended to guide vessels entering into barred harbors, when (from heavy weather or other causes) pilots cannot be had, should be carefully systematized. The board presents in the appendix (I., No. 1) the system of Captain Fenoux, of the French Navy, depending upon the positions of a movable triangle fixed to a pole or mast, or to a light-house; and that of Lieutenant John Rodgers, United States Navy, by a flag to be used in a boat or on shore.

Surf-boats and life-boats should be furnished to certain light-house
stations, and the means of readily providing crews for them in time of need be furnished.

They should be planned by, and constructed under the direction of, competent persons, who would study all the details of their use, and make it certain that when required they could be launched and effectively manned.

The trustees of the Liverpool Dock Company (England) have, under the admirable management of their very able marine surveyor, (Wm. Lord, Esq., R. N.,) of that port, a most perfect system for the relief of the shipwrecked.

There are nine life-boats stationed at different points around the bay and port of Liverpool. The boats are constructed on the most approved principles, kept on carriages in the boat-houses near the shore, and horses provided to enable them to proceed to the most advantageous spot for launching. A gun is placed at each station to summon the crew, besides distress flags placed at each light-house, light-ship, and telegraph station. The arrangements are so perfect, that in many instances the life-boat has been manned, launched, and on her way to the wreck in seventeen or eighteen minutes from the time the distress signal was made.

The life-boats are manned by picked boatmen of Liverpool and picked fishermen along the coast, who reside near the boat-stations, and who are familiar with the banks, swashways, tides, and currents in Liverpool bay. The whole of the boatmen are kept on constant and permanent pay, and are regularly mustered and exercised once a month, and no expense has been spared in rendering the boats, their equipments, and crews as perfect as possible.

The Liverpool arrangements are well worthy of imitation for many parts of our dangerous coast, (especially during the winter months.) The board cannot too strongly urge the necessity for the employment of more efficient means than now exist, at the points where life-boats have been authorized by law to be placed.

LIGHT-BOATS AND THEIR ACCESSORIES.

The first cost, large annual expense for maintenance and repairs, and the rapid decay of light-vessels, render this mode of lighting very objectionable, independently of the ineffectual manner in which they subserve the purposes of warning the mariner of danger.

That this description of lights has not received the attention in this country due to its importance as a necessary adjunct to a proper system of sea-coast illumination, is very evident to the board.

That there are many points on our extended sea-coast requiring to be lighted, which will not admit of any other means, is also evident.

It therefore becomes necessary to select those means least objectionable, in an economical point of view, and best adapted to the desired end.

The rapid decay of timber, especially on our southern coast, would seem to suggest the propriety of employing more durable materials. It is stated by the general superintendent of lights that these vessels last from five to ten years. To obviate the necessity for renewing them at
such short periods, iron vessels might, with great propriety, be substituted. The experiment has been tried in Europe with perfect success.

The advantages of iron over wood for the construction of light-vessels are self-evident. Durability, buoyancy, and economy of first cost are the advantages, without any conceivable disadvantages that could arise from their introduction.

The inferiority of those vessels seen by the board, the large sums appropriated annually for their support and repair, and the small amount of usefulness arising from their employment, warrant the board in recommending a better class of vessels; to be built of iron, and filled with the best parabolic reflectors and Argand lamps, similar to the N.W. light-ship at Liverpool and those generally employed by the Trinity House Board and Irish Board. Proper distinguishing marks by day, as well as the distinctions of the lights at night, should not be neglected, and the board cannot do better than recommend the Liverpool and other English light-vessels, as proper models, in every respect worthy of imitation.

There are many points on our southern coast, especially in the sounds and bays, where small light-vessels are now placed, at which screw-pile foundations might be substituted with great advantage to the navigator, and in an economical point of view. Structures on screw-piles costing in the aggregate much less than the light-boats, and affording a more powerful and efficient light, would, in the opinion of the board, conduces greatly to the efficiency and economy of this branch of the lighting service of the United States.

The apparatus of the light-vessels of this country is so far inferior, that most intelligent and disinterested persons engaged in commerce and navigation pronounce them useless.

The example of the Trinity House Corporation, Liverpool Lights Establishments, &c., in fitting up their light-ships with 21-inch parabolic reflectors and Argand lamps and burners, has not been followed in this country. While the light-vessels of this country are comparatively useless, those of Great Britain are in many instances equal, and in all nearly so, to those placed in towers on the shore. The introduction of movable machinery, with the view to distinguishing these lights, is not of very recent date in Europe, though not known here.

The removal of light-vessels from dangerous and important points on the coast, without due notice, (a source of almost universal complaint by masters of vessels,) is an evil that cannot be remedied too soon. It has not been many days since the finest steam-frigate in the Navy struck on a dangerous shoal, properly laid down on the coast-survey chart, in consequence of the absence of the light-vessel from her position. Light-vessels seldom break away from their moorings in England, and are never taken away from their positions without previously placing a substitute. This branch of the lighting service of this country is probably the most defective. Properly modelled, built, and moored light-vessels, fitted with the best apparatus, and placed under the charge of competent masters, with ample crews, governed by the most rigid rules and regulations, and subjected to frequent visitation and inspection, can alone subserve the great interests of navigation in this branch of the lighting service.
MATERIALS AND MODE OF CONSTRUCTION.

The materials of the buildings examined by the board were very numerous, and variously worked. They were generally and properly such as the vicinity of the house afforded, bricks being generally used where no stone was at hand. Some of the towers were of cut stone, some of cut and rubble, and others of rubble, the latter predominating, and, when well put up, answering all the purposes. Some of the beacon towers are constructed of wood.

Tide-light towers, and for beacon-lights, employed for rangers or leading marks in crossing shifting bars, should be, as a general rule, built of wood, and placed on skids or wooden railways, to permit of their being moved as necessity requires.

PROCURING MATERIALS AND SUPERINTENDENCE OF TOWERS AND OTHER NECESSARY BUILDINGS WHILE UNDER CONSTRUCTION.

Under this head the board refers to another part of this report for a full discussion of the subject, by their committee, composed of the two engineer officers, serving as members.

SECURING THE FAITHFUL OBSERVANCE OF CONTRACTS.

The board is of opinion that great pains have been taken in drawing contracts, and insisting upon their execution. Professional advice is, however, essential to security on this point. A knowledge of the qualities of stone, cements, mortars, and other materials used in their construction, is not to be acquired in a day, and belongs only, as a general rule, to a competent engineer, architect, or builder.

This is equally applicable to the construction of light-boats, beacons, and their accessories.

Thousands of vessels are built annually by persons fully competent to construct vessels for coasting, bay, and river navigation, but who would be greatly at fault in the laying down and constructing, upon proper principles, a light-boat to be placed in an exposed open sea position. The ability required to design a perfect sea-boat, to cross the Atlantic under sail or steam, is equally necessary to design and construct a vessel to be placed at anchor off the bay of New York, South shoals of Nantucket, or, as in England, at the Saltees, Leman, and Ower, and Goodwin sands, &c.

That our light-vessels have not been modelled and constructed by the ablest naval architects, is a fact which the vessels themselves will prove.

CONDITION OF TOWERS AND OTHER BUILDINGS.

The best masonry which the board examined was in the old tower of Sandy Hook light-house, built in 1762; the light-house tower of Cape Henlopen, built in 1764; and the Cape Henry Light-house tower, built in 1791. The best modern towers seen were the one of cut stone on Robbins' reef (wood-work not so good) and the harbor-light tower at Newport, built under the direction of the Engineer Bureau of the Army. Among the worst towers visited by the board were the two at Navesink,
Beavertail, Delaware breakwater, (built in 1849,) Cape May, (built in 1847,) and Cape Henloopen beacon.

The towers of most of the sea-coast lights are too low. The greatest height being sixty-five feet, (see letter of general superintendent of lights.) It seldom happens that a proper location can be found sufficiently elevated, with so low a tower, to give a sufficient range to a first-class light; and on our low southern coasts, where there is seldom a greater elevation than ten to twenty feet, and in many cases not more than five feet above the highest tides, this elevation is totally inadequate.

A light placed on a prominent cape or point should be not less than 150 feet above the mean sea-level, to enable the mariner to be warned of his danger in time to shape his course, with the least loss of time, for his destined port; or, in the event of bad weather, to haul off with comparative safety. Should there be dangerous rocks or shoals off this cape or point, then it becomes necessary to take this additional element into the calculation. A light placed on a coast of not sufficient elevation and power to be seen to seaward of hidden rocks and shoals, is not only useless, but is, in itself, an element of danger to the navigator, who, supposing it can be seen beyond them, may be led into the "trap." From an elevation of fifteen to twenty feet above the sea-level, a light one hundred and fifty feet high may be seen from nineteen to twenty nautical miles in the ordinary state of the atmosphere, provided the illuminating apparatus is of the best description, and properly placed and attended.

One of the most serious evils discovered by the board, in examining light-house towers, &c., was the many leaks in the lanterns and towers themselves, which tended greatly to the injury of the apparatus and of the light, and the rapid deterioration of the building. The lanterns were found, in general, to be too small and too heavy; the astragals, in most instances, being so enormously large as to destroy much of the light from the lamps by interception. The interior of the lanterns, with few exceptions, was without paint, and very rusty; or, if painted at all, black, to the great injury of the light. The lanterns being of wrought iron, necessarily require much more paint, care, and attention, and more frequent renewal, than the better metal, (bronze or gun-metal.) The rain, dew, &c., running down from the top of the upper part of the astragals of a wrought-iron lantern, become discolored, and leave on the glass of the lantern deep stains, which are difficult to remove, and which absorb much of the light in its passage to the horizon.

Ventilation is scarcely known in any light-houses visited by the board. Those intrusted with the lights seemed to be perfectly ignorant of the first principles of combustion and illumination. In some of the lanterns, while the lamps were well trimmed, and in other respects well cared for, there was so great an amount of carbonic acid that it not only prevented the lights from burning clearly and brightly, but it affected the breathing of those who were present. The ventilators, as a general rule, were not only badly contrived, and in some instances not easily used to advantage, but were either permanently closed or never opened at all. The evidences of bad combustion, and consequently waste of light and oil, were apparent also in the quantities of soot in the interior of the
lantern and dome. The reflectors and glass chimneys in many lights were smoked to such a degree as to render the latter injurious to the lights, and to the great permanent injury of the former. Leaky and badly ventilated lanterns, and the want of curtains to protect the apparatus when the lights are not lighted, tend greatly to the rapid deterioration of the illuminating apparatus and machinery employed in our light-houses. Constant and large repairs are required annually, and in spite of the large sums thus expended, the apparatus is not creditable to the country, and to the present state of science and the mechanic arts.

The tanks for oil are not fitted with the care and attention which the service demands. The oil, for want of proper underground cellars, is kept on the lower floors of the towers, with an occasional exception of the cellar of the dwelling of the keeper. Both places are equally bad; oil should not only be kept in a temperature which would always insure a perfectly fluid state, but it should not be placed where it could, by any possibility, be subjected to great extremes of heat and cold.

Another remarkable defect in all the light-house towers visited by the board, was the want of storerooms for supplies, other than oil; wicks, chimneys, cleaning powder, rags, and skins are kept in places which forbid the possibility of keeping them free from sand and dirt. The bad condition of many comparatively new reflectors attests this fact. Spare articles are thrown together without regard to the character or quality of the articles, and greatly to the injury of them.

The frequent necessity for repointing the towers, (the materials and mechanics being necessarily, as a rule, brought from a distance,) is an evil which can only be remedied by the introduction of a better system of repairs.

The keepers' houses are, with few exceptions, in bad repair; having been originally badly built, are a constant demand on the Government for large annual repairs. Many of these buildings are comfortless, and ill-adapted to the purpose for which they were designed. The remedy for this evil is only to be found in a system which will place engineers of respectability and capacity where, now, contractors alone are held responsible.

The light-boats visited by the board afforded very little to commend. The one off Sandy Hook was clean, and in every respect in good order. One of the five boats visited had no one aboard but a negro boy; and another, placed in a most important position, had neither the master nor mate on board. These vessels were not in good order generally. The apparatus, which has been spoken of elsewhere in this report, is of the rudest and most inferior description, affording lights comparatively valueless to the navigator, at a large annual expense.

The forty-two light-vessels now in existence, if necessary to commerce, (and the fact of their being in existence in conformity to law is sufficient evidence of it,) require to be fitted with parabolic reflectors and Argand lamps.

This might be accomplished, in part if not wholly, by taking the largest and best reflectors now in our sea-coast lights for that purpose, and substituting the lens apparatus for them, as proposed, (see programme for lighting the entire coast, a part of this report,) by which means two
essential objects would be accomplished at once, and at the expense of only one, and at the same time introduce an economy of four to one in all the sea-coast lights thus renovated, if the point be conceded that no first-class light ought to be left with one keeper; but if that point be contested, contrary to the experience and good sense of all the rest of the maritime world, then at a very great saving, with the additional keepers and lights equal to the demands of the times.

Many of the lanterns are yet fitted with small glass, imperfectly made, and placed in frames of enormous weight, with vertical astragals of width and thickness out of all proportion to the proper size for the required strength.

The glazing, as a general rule, is badly executed with putty alone. This mode has been abandoned long ago, in all well-managed European light-houses. The superiority of the diagonal astragal, and, as a consequence, the triangular panes of glass, is found not only in the advantage of more nearly equalizing the light, but also in the increased stability of the framework, rendering more slender bars equally effective.

No means or appliances are found in our light-houses for replacing, at once, broken panes of glass. A broken pane of glass, during a stormy night, in a light-house without the proper means of replacing it, might, and in all likelihood would, be productive of the most serious consequences. Panes of glass glazed in frames, and padded with cushions, should be in readiness, at all times, in the light-rooms of every light-house on the coast. With these “storm panes,” only a few minutes are required to replace those broken with the force of the elements, or by sea-fowl.

To prevent too rapid condensation of the heated air, double domes are essential. The best material for lanterns, is copper for the domes, (which should be double,) and gun-metal for the astragals. These important points in light-house engineering are not known, or carried out, in this country, practically, although essential to the existence of good lights, and never overlooked in this branch of the public service in other countries.

The interior of light-house lanterns and domes should be kept perfectly clean, and painted with the clearest white paint. This operation should be repeated as often as necessary, to keep them white.

The ventilators should be so constructed as to enable the instructed keeper to regulate the quantity of air necessary for his lights, without difficulty. The best form is that of the circular register.

For reflector lights, each lamp should have a copper tube, (Farraday’s,) so fitted as to come down over the top of the glass chimneys, with the upper end leading into a large copper ball, through which the heated air and gases escape, and thence through the top of the lantern.

These tubes have been found to increase, to a small extent, the consumption of oil, with a greatly increased brilliancy of light. The expense of them would be paid for, in a brief space of time, in the saving of paint for the interior of the lantern, and of glass chimneys alone; as the whole of the smoke and gases are carried off through them, and at the same time the flames are kept so steady as to produce a great saving of chimneys.
In dioptric lights a ventilator and regulator are employed, having for its advantages the same results.

Stoves, oil heaters, and frost lamps for lanterns, are extremely objectionable, and should never be employed, except in cases of absolute necessity, and that necessity should be determined, alone, by the engineer of the light-house establishment.

FLOORS, LIGHTNING-RODS, WEATHER-COCKS, &C.

The floors, in the towers, are generally of the roughest material, and such as renders it almost impossible to keep them in proper order. In attaching the lanterns to the towers, sometimes over soapstone floors, and sometimes over pine plank covered with sheet copper, but little professional skill has been exhibited. Disastrous leaks and heavy repairs are the consequences.

Lightning-rods are too often found neglected, and in such a manner as to render them dangerous, instead of a protection to the buildings. In some cases they are found to be broken off far above the ground; in others, in contact with iron bands around the towers, and more frequently lying on the ground, without any one, attached to the building, knowing the object for which they were placed there.

The vanes on the tops of the light-house towers, having to perform the important office of conducting the smoke and gases arising from, too frequently, bad combustion in our lights, should be fitted with great care and attention. This, however, is not the case. The dome being single, and the vanes badly fitted, the rain, and frequently the high winds, drive down into the lantern, causing the lights to burn badly and injure the apparatus.

PERFECTION AND IMPERFECTION OF THE ILLUMINATING APPARATUS.

On this subject, the board is constrained to say that the illuminating apparatus of this country is generally imperfect of its kind, and of a kind which has been abandoned, to a great extent, all over maritime Europe, and is gradually becoming obsolete everywhere.

The consideration of the systems of illumination of France, Great Britain, and other countries of Europe, where modern improvements have been introduced, or are gradually introducing, will prove that reflector lights are being abandoned for better and more economical systems.

Good reflectors, of the kind and form used in the best conducted lights, reflect but about one-half of the light which is thrown upon them. Imperfect ones much less.

On one of the newest reflectors which the board examined, the silver was not over $\frac{1}{2}$ of an inch thick, and was not firmly fastened to the copper. The surfaces, if irregularly formed, are soon scratched by rubbing with tripoi powder, which is supplied to the light-keepers for the purpose of cleaning the reflectors.

The shapes of many of the reflectors are not parabolic, and the portion of the parabola, in other cases, is taken at random, instead of being regulated by the divergency required for the light. The light is not in
the focus of the paraboloid, and, in many cases, has a movable position from night to night. Some of the reflectors are so thin that, if originally of good figures, they could not be expected to retain them. The depth of Boston light reflectors, of 21 inches diameter, made by Wilkins, London, is \(\frac{8}{9}\) inches; those at Bald Head light, made in Boston, are 12 inches.

Adequate pains are not taken in their construction, so as to permit exact adjustment in position, upon which much of their efficiency depends. If adjusted originally, they cannot retain their position, being removed for cleaning, and having no adequate provision to insure that, when replaced, they will be precisely in adjustment.

Much of the difficulty of adjustment may be obviated, by introducing reflectors fitted with Mr. Alan Stevenson's lamp, and a code of carefully drawn up instructions to light-keepers, who should be well drilled in the use of the apparatus, by a competent person. (See description of Mr. Alan Stevenson's sliding-lamp, in Senate Doc. No. 448, first session twenty-ninth Congress; and also in his rudimentary treatise on light-houses; and in his description of the Skerryvore light-house, &c.)

The lamps and burners of the lights are nearly as various in pattern as the lights themselves.

Tin fountains are common, requiring frequent repairs, and often leak so badly that the keeper cannot keep the floor of the lantern free from oil.

Some of the more modern lamps are made of brass; are heavy, and apparently durable. The important point of regulating the flow of oil by a proper cut-off, has not received the attention which it deserves; the tilting process, destructive to the usefulness of the light, is often resorted to by keepers, to diminish or increase the flow of oil. A lamp made upon proper principles, and thoroughly tested afterwards, will never require to be removed from its horizontal position.

The burners are made of iron or brass, and in some cases of both; that is, in some instances there were found to be caps of iron, to be taken off and put on, the lower part being of brass. This plan produced galvanic action in the two metals, and consequently rapid deterioration. The burners are both too heavy and too thick. Much of the useful effect is lost by the imperfect combustion induced by this heavy burner: The best and most universally approved burner for Argand lamps is that made of tin, and tipped with silver. This burner is believed to be much more economical than the cheaper and more common ones.

While the deterioration of light is evident from the thick iron burner, its superiority is equally apparent from the thin tin burner. Universal experience in Europe, and in domestic concerns everywhere, attest its truth.

The Argand burners are generally greatly neglected by the keepers, not having been taught the necessity of keeping the tube for the interior current of air as clean as possible; they seldom scald the lamps to clear them of carbonized wick, gummy oil, &c.; consequently the lights become dim in proportion as they are neglected in this respect.

Instructions are required for trimming the lamps, elevating and turn-
ing down the wicks, regulating the flow of oil and the like, nothing of which is understood by the keepers in this country.

Proper trimming scissors are not furnished, although essential to the proper performance of the duty.

Among the older lights, the lamps and reflectors are firmly fixed to a movable circular frame or chandelier. They are placed too far apart on the frame to produce a powerful and concentrated beam of light, while it not unfrequently happens that many of the reflectors face towards the land or iron door of the lantern. Those more recently fitted with apparatus, are so arranged as to allow the lamps and reflectors to be placed nearer to or further from each other, as the keeper may think proper, both vertically and horizontally. Notwithstanding this latter arrangement, the reflectors are in almost every instance too far apart.

The frame or chandelier is made to revolve in consequence of the contracted dimensions of the lantern, to enable the keeper to bring the lamps and reflectors to him to clean, instead of having to walk around the apparatus. The frame being movable is a serious evil, as the keepers, as a general rule, set the frame by guess, and very seldom twice precisely in the same position.

There is no system, nor are there any written or printed instructions, for cleaning the illuminating apparatus; keepers use their discretion entirely in this as in almost all other matters which they may do well or ill, without the fear of any rebuke.

The tripoli furnished for cleaning the reflectors is not fit for that purpose. Reflectors cleaned with this powder must become inefficient very soon. Silver can be cleaned properly only by the use of the best whiting and rouge. Tripoli is used for brass work, elsewhere than in our Light-house Establishment.

The cost of reflectors, lamps, &c., is small, compared with that of the oil used in them, which is a daily expense, and true economy requires that if reflectors are used at all, they should be of the best quality. The difference in cost of the best silver 21-inch reflectors, and a common 14-inch one, such as is used in some of our largest lights, is, according to the present contract by the general superintendent, about $40, the interest on which is $2 40, which is equivalent to fifteen nights' consumption of oil for one lamp. Imperfect reflectors give inefficient lights. It is easy to lose 20 to 30 per cent. of light in this way; requiring ten lamps to do the work of seven or eight, and consuming one-fifth to one-third more oil, therefore, nightly in the operation.

The very great economy and efficiency of the lens or Fresnel lights, as contrasted with the reflector lights, will appear in the course of this report. It amounts to a gain of at least three and a half (3.6) to one, on an average, when the two systems are equally well fitted and cared for, and in some cases to four times under similar circumstances; while under the present system, in this country, it is not doubted the saving would be much more in the aggregate.
CHARACTER OF THE VENTILATION.

The ventilation of the lanterns is of great consequence; for if the carbonic acid produced by the lights in burning is not carried off, it is not only injurious by taking the place of so much oxygen, but positively prevents combustion. A light will go out in a mixture of common air and carbonic acid, when a very considerable proportion of oxygen is present. The carbonic acid prevents perfect combustion, and the smoke interferes with the passage of the light, which is at the same time enfeebled in its brilliancy.

It has already been stated that the ventilation of the lanterns of our lights is very imperfect. Trap and other doors to the lanterns can never afford proper ventilation. Strong currents of air under some circumstances may be produced by them, but not a uniform one, such as the lights of a light-house require.

In one of the light-houses visited by the board, which was otherwise well kept by a careful and worthy man, the ventilation was so imperfect that respiration was affected, and of course the lights were deficient in whiteness, which is the result of perfect combustion. Simple rules upon these and other points are required for the instruction of the light-keepers. They should also be practically taught their business for a time, and a certain amount of knowledge should be required of every man who undertakes such a trust—one involving in its execution, according to knowledge, not only property but human life. Faithfulness without knowledge will not suffice. It is a great mistake to suppose "the trimming and cleaning a small Argand fountain lamp are so simple and self-evident as to be safely left to the intelligence of the meanest capacity." On the contrary, the board can readily understand that the general superintendent of lights, &c., has "had much inconvenience and difficulty to encounter from the frequent changes * * * in the light-house keepers, who for a time do not understand the management of their lamps, and consequently keep bad lights and waste much oil."

GENERAL POLICE AND REGULATION OF THE ESTABLISHMENT, CLEANLINESSE, &C.

There are no general police regulations for the lights of this country. The only instructions to keepers are embraced in nineteen lines of ordinary type, merely specifying the time of lighting and extinguishing the lights, directing that the lanterns, lamps, and reflectors are to be kept constantly clean and in order, &c., and that the lamps are to be trimmed every four hours. That these simple requirements are not carried out, is evident from the notes of inspection appended to this report. The instructions to keepers of floating lights are in every respect similar to those for the lights on shore, with the addition of three articles relating to the care and preservation of the vessels. A reference to the instructions for the lights of Great Britain, France, &c., will clearly show the necessity for similar ones for this country, and the proper means to enforce them rigidly. The mere nominal annual inspections of the lights by the collectors of customs is productive of no good. The keepers know about what time to expect these visits, and are better prepared
than at other periods of the year to receive them; besides, it is impossible that the collectors of the customs can have any knowledge of illuminating apparatus and its adjustments. These visits are very short, never extending over an hour or two; rendering it impossible that beneficial results could accrue to the establishment from this mere nominal inspection.

The fact that the police and general regulations of the light-house establishment, *if such can be supposed to exist at all, are exceedingly defective*, is too apparent to need more than the bare assertion.

In reference to this subject the board would refer to the following extracts from Congressional Documents, which have a direct bearing upon it:

In House Doc. No. 811, 27th Congress, 2d session, the committee say:

“In the opinion of the committee there should be established a plan of inspection more efficient. Frequent visitations and minute examinations by competent inspectors would insure vigilance, economy, and order on the part of the keepers. The inspectors should be men thoroughly acquainted with all the details of light-house management and superintendency, with the manner of adjusting the lamps and reflectors, and of keeping them in order.”

“The collectors, acting as superintendents, cannot possess that information and practical knowledge necessary to a perfect administration of the system. The mode of conducting it has formed no part of their studies. They lack both theory and practice.”

In a report made to the Senate by the Committee on Commerce, in 1888, (Senate Doc. No. 428,) it is said: “The lights should be visited by a general inspector, who is master of the whole subject; being fully capable of estimating the true character of the apparatus, its condition, the manner in which it is managed, whether the keepers are capable and faithful, and whether the oil is such as it should be.” “In short, this visitor should be so thoroughly skilled, in everything pertaining to the subject, as to keep the light-house in as perfect a condition as the arts and the progress of science will allow.” Again: “We have already said that certain collectors of the customs are the inspectors of light-houses in their respective districts.” “It is manifest the two offices have no natural connection, for they require qualifications quite different. The one should understand the laws of light, as it is affected by reflectors and refractors; the other the character and value of merchandise: and there is no affinity between the employments; nor does it follow that one who is well qualified for a collectorship has a particle of that information which is essential to a well-conducted system of lights.” Again: “The number is great; the duty is merely collateral; their visits are seldom; and their attention little engaged in the matter. They have no control over the system; have no knowledge beyond their districts; and the consequence is, that their inspection is generally of little importance, and has but little tendency to expose the faults or improve the character of the system. Indeed, so necessary is some other inspection, that the contractors who furnish oil are required to review and report upon the condition of each light; and so also are the immediate keepers.” “The subject was early committed to the col-
lectors, as a matter of convenience; but we may well inquire now, whether its importance does not call for a more skilful supervision; one that can give harmony and character to the whole system, and make it not only keep pace with the progress of population and business, but with the advancement of mechanical and scientific improvements."

The committee (Doc. No. 811, 2d session 27th Congress) say further: "In the opinion of the committee these views are entitled to the respectful consideration of Congress." "The appointment of inspectors, whose duty it shall be to devote their entire time, under the direction of the general superintendent, to frequent examinations of the light-houses, light-boats, buoys, &c., would be attended with no great increase of expense. The amount now paid to the collectors acting as superintendents is about eleven thousand dollars. There is already attached to the establishment a small vessel."

The foregoing arguments appear to the board to be unanswerable, and embody all that they could say on this very important branch of the subject.

REGULARITY OF LIGHTING AND EXTINGUISHING, AND MODE OF SECURING IT.

This important branch of the light-house service is left wholly in the hands of the keepers.

In few instances, only, did the board find the keepers contending that they had carried out the instructions to light at sunsetting and extinguish at sunrising. The execution of this part of the service faithfully and punctually, is one of great consequence, independently of the principle involved, which cannot recognize any discretion on the part of the keepers, in this or any other branch of the service. It is, in itself, important to the navigator that the lights should be lighted punctually at sunset, and not extinguished before sunrise; but if the keeper is to decide as to the necessity or not of so doing, he may decide, if it suit his convenience, (and one instance, at least, has been known) during fogs, gales, or other conditions of the weather, to turn down the lamps so low that the lights would be totally useless, under the most favorable circumstances of weather. It is during fogs, in heavy gales, &c., that it becomes the duty of the intelligent and faithful keeper to exert himself most, to keep up a bright light. Stringent regulations in detail, under frequent inspections by competent persons, can only remedy this evil—one that increases daily under the present management.

The want of inspections places the keeper above all authority, inasmuch as there are very few persons who are willing to volunteer to perform the ungracious task of finding fault with his neighbor, and possibly his friend, when in all likelihood, if he were public-spirited enough to do so, his motives might, and most probably would, be impugned.
MODE OF PROCURING AND DELIVERING SUPPLIES, AND OF TESTING THEIR QUALITY.

This important subject has not been fully and clearly explained to the board. The communication of the general superintendent of lights, &c., June 7 and July 3, 1851; the communication of the collector at Boston, (the actual purchaser of supplies,) and that of Jonathan Howland, master of one of the vessels employed to deliver the articles of supplies, are not as satisfactory as the board could have wished.

It is very evident to the board that the employment of the terms "competent person" in relation to the testing of oils, apparatus, &c., and also in the construction of the latter, is too vague and indefinite to be worthy of implicit credence, or to carry with it much weight.

In the Trinity House corporation of London, the important subjects of experimenting upon different descriptions of combustibles for light-houses, testing the mathematical perfection of apparatus, investigating the important subject of ventilation, &c., are confided to the world-renowned Michael Faraday; upon the subject of construction and its accessories. Mr. James Walker, a distinguished civil engineer is employed. In Scotland, the lights and other aids to navigation, are under the immediate direction and supervision of the able and distinguished engineer, Mr. Alan Stevenson. In Ireland, also, the lights are in charge of a competent engineer, (Mr. George Halpin, jr.) In France, the admirable system commenced by Augustin Fresnel, the distinguished savan and academician, was carried out by his worthy and distinguished brother, Léonor Fresnel, who placed it, five years since, in the hands of his friend and associate in the "Ponts et Chaussées," the learned and accomplished Reynaud.

To expect that our lights could compare, in point of excellence and economy, with systems so constituted, as these named, would be to expect order out of anarchy and confusion, and perfection out of such various and imperfect elements.

The article of oil, the most important in the list of supplies, should undergo the most rigid inspection, test, and scrutiny, before being received for use in our light-houses. There is no article of commerce more easily adulterated, and no article of supply, for lighting purposes, so necessary to be of the best quality; the existence and usefulness of the lights depending mainly upon its good quality. The present habit of procuring two kinds of oil, "summer and winter," is extremely objectionable. The difference in price (judging by the contract) is very small, while by this mode a door is opened to the introduction of an inferior article, difficult to detect, and ultimately productive of much evil. The lights are only visited once a year by the supply vessel; and as nearly as can be estimated, the quantity of oil, &c., is left. The quantities of the two kinds of oil to be left, are decided upon by the master of the vessel. The keeper has no means of knowing "winter" from "summer" oil, and therefore is compelled to take the word of one who may be interested in the article. When bad oil has been left (a circumstance of very frequent occurrence) the keepers have been compelled to use it, however bad the lights produced by it were. The collectors acting as superintend-
ents, as a general rule, being very far from the lights, could not remedy this evil wholly, under the present system; but if it were otherwise, the collectors have no authority to act except in cases of extreme necessity.

There should be but one kind of oil used, and that should be of the best quality. So long as we persist in using a more expensive and more easily adulterated oil, for our lights, than the rape-seed or colza oil now used universally in France and on the continent of Europe generally, in England, Scotland, and Ireland, it becomes the duty of those charged with the management of our lights, placed for the protection of life and property, to discard all false economy, and cause the best article that can be procured to be furnished to our lights. Every door to fraud should be closed. A scientific person of known ability, and of high moral and social standing, should have the duty confided to him of testing and receiving all combustibles, apparatus, &c., for light-house purposes.

Among the articles of light-house supplies, that of glass chimneys was most defective. They were irregular in shape, size, length, and thickness. This, too, is a branch which, at first blush, might seem so simple that it might be comprehended "by the intelligence of the meanest capacity." However, such is not the fact. If they are too short, there is not sufficient draught, and consequently imperfect combustion. If irregular in shape, the flame is liable to approach nearer one side than the other, causing unequal heat, and consequently breakage. If unequally thick, they do not become uniformly heated throughout, and breakage is the necessary consequence. The quality of the glass, too, is an important item, for upon it depends whether much or little of the emitted light is absorbed.

It has been ascertained by experiment, by the French light-house commission, and by others, that a particular shape for these chimneys is the only proper one. The model for the manufacture of them is preserved at the central light-house workshop in Paris, and sent thence to those who furnish them. Before being received from the contractor they are all rigidly inspected, and then, on the least defect in color, shape, or quality of the material, are refused.

The next most important article of light-house supplies is the wick for lamps. Upon the material of which they are made, whether loose or close, &c., also depends the efficiency of the lights. This subject seems to have attracted very little attention in the management of our lights. The beautiful specimens of chimneys and wicks for the different kinds and orders of lamps and lights, sent to the board from the "Commission des Phares," by their secretary engineer, Mr. Reynaud, when compared to the many inferior articles in use in our light-houses, show at once the little attention which has been paid to this important branch of the service in this country.

It may be remembered, at the same time, that one of our glass establishments received a gold medal for a specimen of superior glass sent to the World's Fair in London, last May, which is of itself sufficient evidence that we can produce such an article at home as the service demands. For reflector lights, the cleaning powder and buff-skins are
important items, and upon the good or bad quality of them the durability and usefulness of the apparatus greatly depend.

The "tripoli" powder, found in our lights, was gritty, and unfit for cleaning silver. Many of the reflectors seen by the board bore strong evidence of this fact. Various articles of this kind are employed in foreign light-houses, but it is believed that pure whiting and rouge are the only articles adapted to this special service. Proper places should be fitted for keeping these articles, in each light-house tower; which is not the case now.

Spare lamps, burners, &c., should be made to conform to the articles in use in the respective light-houses. Reflectors of different sizes, shapes, and qualities, burners of different sizes and thicknesses, all tend to produce a light of unequal intensity in the different azimuths.

The present mode of delivering light-house supplies is objectionable. The short time spent at each light by the master of the vessel, forbids the possibility of an adequate execution of the duties confided to him—those of repairing the apparatus, especially.

Taking the prices contained in the printed estimates as a guide, the articles furnished to the different light-houses are of an inferior quality. No lists of articles for the lights are kept. Different lights are furnished with different articles, and in different quantities. No discretion should be left in these important matters of detail to any one. Lists, containing a necessary number and quantity of each article, for each class of light, should be printed, and each keeper should be furnished with them. The person charged with the delivery of supplies should examine the book of expenditures which each keeper should be required to keep; see that all the articles not expended are properly accounted for, and in good order, and all deficiencies supplied, to the extent of the allowance list.

Extraordinary consumption should be inquired into, both for very small and very great expenditures. Very small expenditures afford evidence of bad light; while extravagant ones may be the result of improper application of the stores.

Supplies should be delivered more frequently. This course would tend to correct abuses and evils, which, under existing circumstances, can find no efficient remedy. For lights near large cities, difficulties arising from the supply of bad articles can be comparatively easily remedied; but at isolated and distant points, on a sparsely-settled coast, it is almost impossible to do so by a single annual visit from the collector, and from the supply-vehicle, which happen about the same time on nearly the entire coast.

Instead of, as now, employing on the Atlantic coast two sailing vessels, for nearly the entire year, in making one visit to each light, the same service could be much more effectually and economically performed by a small steamer, which could visit every light on the entire Atlantic coast three times during the year; thus affording the keepers opportunities of making known their wants and complaints, and at the same time exert a salutary influence upon the keepers, by pointing out defects in the management of the establishments.
PURCHASING AND DELIVERING SUPPLIES, TESTING, &c.

This branch of the light-house service is, in the opinion of the board, so contrary to true economy and the interests of commerce, that they cannot too strongly urge the necessity for a thorough change. The experience in this branch, in France and Great Britain, may well be brought to our aid. (Vide letter of M. Léonor Fresnel, Senate Doc. No. 488, 1st session 29th Congress.)

MODE OF PROCURING THE SERVICES OF PROPER PERSONS AS KEEVERS.

The salaries paid to the light-keepers render the offices subjects of competition; and if skilful and competent men are not procured, it is not the fault of the department by which these compensations are fixed. The appointments are either made or recommended by those collectors who are superintendents of lights, in the different collection districts. The degree of general intelligence, and special acquaintance with their duties, activity and interest in their occupation, manifested by different light-house keepers at the stations visited by the board, was very various. In general, much interest was shown, and in a few cases much mechanical ingenuity.

The frequent changes in the persons employed, not resulting from neglect of duty, or want of qualification on the part of the incumbent, are necessarily very injurious to the efficiency of the light-house service.

In some branches of our public service examinations have been resorted to, with the happiest effect, in testing the qualifications for entering the service, and in subsequent promotions. In some foreign countries meteorological and tidal observations are required of the light-keepers, to secure adequate intelligence for the position, and to insure due diligence in the execution of all the duties devolved upon them. There would be a positive and direct gain in efficiency, if the first system were introduced; and the use of the second would promote, incidentally, the same object. There is quite time enough for making such useful observations; and the moral effect would be to greatly elevate the office in the minds of many, who only view it now as an easy berth for the needy, or for those who are incompetent to perform more laborious service.

MANNER AND FREQUENCY OF INSPECTION—PERSONS BY WHOM MADE.

All experience shows that frequent inspections of light-houses are essential to maintaining an efficient system. These inspections, by competent persons, (engineers of the corps of Ponts et Chaussées,) are carefully provided for in France; by members of the Trinity Board in England, and by the engineers of local establishments, such as that of the port and bay of Liverpool, and the engineers and their assistants of the establishments of Scotland and Ireland.

The vigilance which is secured by inspections at irregular intervals is of greater value than even the direct results of an examination. Our system, at present, is quite deficient in this respect; a single annual visit from the collectors, who are superintendents of lights, and the visit of the employé who delivers supplies to the light-houses, &c., (the latter, in some districts, being the only inspection,) is obviously insuffi-
cient. (See Senate Doc. No. 428, 1st session 29th Congress.) The
evident state of preparation in the light-houses at which the visits of the
board were expected, showed that good effects would flow from a system
of inspection.

Such a system could be organized with very little, if any, additional
expense to the Government, which will be discussed in detail in another
part of this report.

The efficiency which would be gained by thorough inspection would
justify additional expenditure, if it could not be reached without it; but
it is believed to be clearly demonstrated, elsewhere in this report, that
the present annual expenditure for commissions on purchases, distribut-
ing supplies, and nominal inspections, would be ample, under the system
proposed by the board, to produce these desirable and beneficial results.
Better have fewer lights and effective, than many without efficiency.

In the district of New York the collector employs an assistant, who is
charged with the care of the lights, beacons, buoys, &c., and who has
under his charge a small vessel for furnishing supplies, visiting the lights,
replacing buoys when displaced, and the like. The zeal of this gentle-
man has been serviceable in the management of this district, and were it
guided by good instructions, and sustained by occasional visits of a com-
petent general inspector, would produce still better results.

DIRECTION AND MAKING OF ANNUAL REPAIRS, AND THEIR SUPERINTEN-
DENCE.

System, in all these points, is indispensable to efficiency and economy,
and should be combined with a good system of inspection. At present
it is at loose ends, the usages varying even in the same district. In
many cases repairs to buildings, wharves, &c., are postponed until decay
has made such ravages that considerable expenditures are required, for
what would have cost but little if applied at first.

The repairs of the lighting apparatus are generally only made when
the supply-vessel visits the light-house; that is, once every year, and
then frequently, as was stated to the board, in a hasty and imperfect
manner. When articles are unavoidably procured from the nearest town
or city, they are often of a kind ill-adapted to the purposes intended, or
unlike, in size, figure, or material, the articles regularly supplied.

Considerable economy, in small matters, would result from a regular
system of applications for repairs, of authorizing, supplying, and super-
vising them.

DETERMINING POSITIONS OF BEACONS, BUOYS, SEA-MARKS, &c.; PLACING
AND REPLACING THEM.

As a general rule only seamen familiar with hydrography, and pilots,
know what beacons, buoys, and sea-marks are required, and where and
how they should be placed. The beacons, buoys, and sea-marks which
would suffice for pilots, with their accurate knowledge of natural and
artificial objects available for safe navigation, are not always sufficient
for mariners generally. Their object is not to dispense with the service
of the pilot, but to furnish him with marks, &c., to provide for cases of
emergency, when the vessel must enter, and may not be provided with a pilot. Small coasting vessels, carrying freights which do not pay well, cannot afford to pay pilotage.

The necessity for the beacons, buoys, and sea-marks recently and at present provided for by law, is inquired into and reported upon by the Superintendent of the Coast Survey, on the examination of officers of the work, and by the chief of the Topographical Bureau. They are then usually placed by pilots or seamen, but sometimes by the officers of the coast survey. When required to be removed on account of ice, or for repairs, or when displaced, they are replaced by contract by the year, under the authority of the local superintendent. The duty of replacing buoys, driven from their moorings, is neither superintended nor executed in a proper manner.

The buoys are usually placed by pilots (who contract to perform the service) by compass bearings, ranges, or by guess; and it has been remarked by the surveyors, that in many cases their places are so much changed in different years as to produce error and even danger. The coast survey officers place them by the known positions of three suitable objects on shore, a measure known as the three-point problem, measuring the angles with a sextant. This is the true mode of placing them and no person should be permitted to put them down who is not competent to use that instrument. When placed, it is indispensable that their position should be verified by a competent officer, that he should report in relation to them to the local or general superintendent, and that he should inspect their positions from time to time, and always when, by accident or design, they have been moved.

**COLORING AND NUMBERING BUOYS.**

Until the passage of the recent law (1850) in regard to coloring buoys, the local superintendents changed the colors at pleasure, often introducing the utmost confusion. No notice of such changes being given to the general superintendent, no changes could be made in the charts of the coast, and the worst consequences might have resulted. Wise legislation has checked this; but it is still true that the examinations of positions, colors, and numbers should be made by competent inspectors, and reported to the Department. Plain as are the directions of the law (vide appendix) in regard to coloring and numbering buoys, there is known to this board one important port in which the provisions of the law have been completely misunderstood, so that a navigator running by the buoys must put his vessel, if of considerable draught, on the bar.

Sufficient care has not been bestowed upon the buoys generally, under the law of 1850. The paint used for coloring has not been, in any single instance that the board has seen, of the best quality. To carry out the design of the act of Congress, the red, especially, should be of the best quality of red lead; the black of the glossiest; and the white of the purest white. Spanish brown and dirty black are difficult to distinguish from each other. Such may be seen almost everywhere along our entire coast.

The spar buoys, being the most common in this country, are inefficient;
difficult to give easily distinguished marks, or numbers; and from their peculiar shape, size, and improper moorings, are too often at such an angle with the surface of the water as to render them exceedingly difficult to be seen.

Can and nun buoys are employed, but not to a great extent, and those used are much too small. The boat buoys, used chiefly on the eastern coast, are very efficient.

In some of the rivers, barrel buoys, equal in capacity to about a sixty-gallon cask, are employed. Iron buoys have been authorized, by special acts of Congress, for the Columbia river, rivers in Texas, Hatteras shoals, &c.

The moorings of buoys in the United States are, as a general rule, very defective. The weight of the blocks of granite, or sinkers of iron, and size of chains, are not sufficient.

For want of proper inspection, buoys frequently sink at their moorings, and part their chains. Too much care cannot be taken to guard against these casualties, especially in important channels; in rivers and on sand bars, lodgments of this kind may destroy a valuable channel.

The important duty of raising and replacing buoys should not be left to the discretion of contractors.

The kind of buoys required, their material, &c., should all be provided for, by competent persons. In regard to distinguishing them, the board will elsewhere make further remarks. The numbers as now placed upon the buoys are very ineffective. The law in regard to coloring and numbering them, however, is deemed all-sufficient.

NOTICE TO MARINERS IN REGARD TO CHANGES IN LIGHTS, BEACONS, BuoYS, &C.

This is a subject which, in the opinion of the board, requires more attention than has ever been given to it in this country. It is not sufficient to publish changes in a local newspaper. They should be published as far in advance of the proposed change as possible, in all the leading commercial newspapers, nautical periodicals, and by placards in large type, with conspicuous headings, and distributed at home and abroad at the custom-houses and offices of the different consulates.

In making changes, they should take place at the precise time designated, and nothing should prevent the perfect fulfilment of the originally published design. Changes of lights in light-houses, removal or placing of light-vessels, should never take place with less than six months' notice; a year's notice would be better. Should a light-vessel break adrift, although replaced within a few days, a notice of both facts should appear together in the same papers, and on the same placards, as the navigator might, otherwise, see the notice of the breaking adrift, and not the other, and thereby be deceived. This is one of the most important branches of the lighting service, and one that can never be perfectly systematized without a corps of competent and efficient local inspectors.

In this respect the Trinity House, Northern lights, Irish board, Liverpool dock trustees, &c., are good models. Notices of proposed changes of lights, buoys, beacons, and of new lights, are to be found in every
part of the globe, and always placed where the navigator is obliged to go before leaving port, (the clearance office, and at the office of the consul of his country.) The admirable system followed by these independent boards, in all the minute details of the service, for the benefit of commerce and navigation, cannot be too highly commended.

Those who have been around the world, and visited nearly every principal port it contains, never saw a notice to mariners, relating to any American light, except by chance in some corner of a newspaper, and that probably a merely local one.

Changes arising from casualties should be published widely in the manner prescribed, and at the same time reported, by the local inspector, to the Department.

No changes should be made except on the authority of the Department, which should authorize at least six months' notice, in all cases of lights.

The looseness of the system in this country heretofore, in these respects, is proved by the fact, that although a circular was issued by the general superintendent of lights, &c., directing the collectors, acting as superintendents of lights, to report to the Superintendent of the Coast Survey all changes in regard to lights, beacons, buoys, &c., that they might be placed upon the charts, but one collector ever complied with the direction.

Changes which otherwise would be improvements, unless known to the mariner, become snares. No list of beacons, buoys, or sea-marks, exists; no description of them can be obtained, except by a general visitation and inspection of them along the whole coast. Having failed to obtain the required information, efforts have been made by the board to procure this important information from the local superintendents, for the purpose of arranging a descriptive list of them. So far, only a few returns have been made, and some of these not full enough to carry out the design.

European light-house boards do not confine themselves to giving notice to mariners of proposed changes, &c., in their own lights, &c., but they cause those in foreign languages to be translated, and as widely disseminated as their own. The Trinity House corporation of London causes the notices relating to lights, &c., on the French coasts, as well as on their own, to be published in the commercial papers in this country.

CONDITION OF LIGHT-HOUSE STRUCTURES OF EARLY DATE, AS SANDY HOOK, COMPARED WITH MORE MODERN ONES, AND CAUSES OF DIFFERENCE.

The board have already stated their conclusions on this subject, in discussing the general condition of the light-houses; and have suggested the remedy for defective construction.

COMPARISON OF THE SYSTEMS OF LIGHTING IN THE UNITED STATES, FRANCE, GREAT BRITAIN, &c.

To make this comparison intelligible, will require a brief notice of the light-house systems of France and Great Britain, with some remarks on the systems of other countries.
FRANCE.

The administrative matters relating to light-houses, though hardly such as it would be possible for us to follow, are, nevertheless, regulated with a system of order worthy of all commendation.

As with us, no light dues are exacted from shipping, but the light-houses are a direct charge upon the treasury, and supported by annual appropriations.

The question, shall there be a light-house at a particular point, is decided by a board consisting of naval officers, government engineers, and scientific civilians.* The first decision that settles that inquiry is desirable. The civil engineer of the department where the work is to be placed, reports his views, with plans and estimates for it, which are laid before the board by their secretary. If it now appears that the work should go on in the manner proposed, the details of construction and the estimates pass to the general council of government engineers, (Bridges and Roads: "Ponts et Chaussées;") and when approved, are constructed by contract, under the supervision of the government engineers of the department. These engineers also superintend all repairs of light-houses. In some cases local boards are required, first, to examine and report upon the necessity for a proposed light, before the subject is examined by the light-house board. The administrative details are in the Department of State, ministry of public works, under which the different persons referred to, serve.

The general arrangement of sea-coast lights, adopted on the report of Rear-Admiral Rossel to the light-house board in 1825, is based upon two principles: that one light of the brightest class shall not be lost sight of until another is visible; and that such distinction shall be presented by the light, that a vessel on nearing the coast, without very gross error in the knowledge of her position, cannot mistake one light for another. Twenty-one nautical miles was adopted as the distance of visibility of the brightest lights, and three classes of distinction were admitted, viz: fixed lights, revolving lights showing a bright light, and an eclipse at intervals of a minute and at half a minute. By placing the fixed light midway between the two revolving ones, of the different kinds, and at a distance of forty-two nautical miles from each other, the essential condition of the system would be fulfilled. In applying this practically, it was, of course, so modified as to conform to the general features of the coast, and to the wants of navigation. Between these brightest sea-coast lights, others of inferior navigation were arranged as required.

Every light is placed under the inspection of a person called a conductor, who visits it at least once a month, by night as well as by day, and is provided with the keys of the building and of the watch-room, so that he can enter at all times, without summoning a keeper. The resident engineer of the department inspects all the lights in his department at least once a quarter, and the chief engineer of the department once a year, and the secretary of the light-house board makes an inspection at least once in three years.

* Members of the Academy of Sciences of France.
The light-house keepers are furnished with books, ruled, and with appropriate headings to the columns, to record the observations required of them.

Detailed instructions for light-houses and beacons are distributed, which direct minutely their duty.

Prior to 1822, Argand lamps with reflectors were used in the French light-houses. In that year, Augustin Fresnel put up the first lens light of his invention, in the tower of Cordouan, at the mouth of the Giroude. In 1825 the general adoption of the lens system was determined upon. In 1845 there were on the coast of France, not including the colonies, 151 lens lights and 47 reflector lights; and nearly all of the latter were merely beacon-lights.

According to Mr. Reynaud's statement* not one reflector light will be left in 1852, in the class of lights of the first and second order.

Experience, then, has led to the substitution of lens lights for the others, except as small harbor beacon-lights, requiring a small arc of the horizon to be illuminated.

The mechanical lamp used with the lens light was the joint invention of Arago and Fresnel, combining the idea of Rumford, of a number of concentric wicks, according to the intensity and volume required for the flame, and the idea of Carcel of keeping the wick from burning rapidly, by making the oil overflow about it, by raising it with a pump, moved by clockwork.

Several kinds of mechanical lamps have, from time to time, been presented for examination and trial, answering, generally, satisfactorily; those used in some of the recent lights are called the "moderator lamp."

The repair of twenty-eight lamps of the first order lights, four of the second and thirteen of the third, amounted, in 1850, only to $183 56.

Mr. Fresnel suggests† that if it be apprehended, that, on account of the distance of a light-house from the workshops, there may be difficulties in regard to the repairs of the mechanical lamp, the appointment of a mechanic as light-house keeper, and the supplying him with the necessary tools, will be a very simple remedy.

In the refracting light the diverging rays from the lamp are rendered nearly parallel, by passing through a glass lens. Several such lenses, forming the sides of a prism, surround the lamp, the light from which is thus refracted into a number of beams corresponding to the number of the faces of the prism, separated by dark angles.

If this prism be made to revolve slowly about a vertical axis, there will be alternations of light and darkness; as the beam from the face of the prism reaches the eye, or it is in the dark angle between the beams. The increase of the light to its greatest brightness, and the decrease again, will be gradual. A prism of eight sides, thus revolving in eight minutes, would show bright flashes at intervals of a minute, and eclipses at the same interval.

The lens is made of a number of pieces of glass, ground to the same curve, and fitted closely together. The building up of a lens in this

† Letter of M. Léonor Fresnel to Lieutenant T. A. Jenkins.
way, of separate pieces, has been carried to very great perfection, and the separate pieces composing it are of beautiful clearness, polish, and precision of form.

A drum of glass, cylindrical in its horizontal sections, and lens-shaped in the vertical direction, placed about a lamp which occupies its centre, will diffuse all around the horizon the rays falling horizontally upon it, bending towards the horizon those coming above or below the horizontal line from the lamp, furnishing a fixed light of equal brilliancy in every direction. A panel of glass, lens-shaped in the horizontal direction, being made to revolve about this, would give a bright flash as the axis of the lens passed any particular point; and several of these, thus made to revolve, constitute a fixed light varied by flashes.

When the whole, of the horizon is not to be illuminated, a reflector is substituted for the lens behind the lamp, so as to throw to the front the light which would otherwise be lost.

Not to lose the light thrown upward by the lamp, a series of glass prisms is so arranged as to receive the rays at the angle at which they are reflected, to throw them downward to the horizon.

Similar prisms, below the lamp, serve to prevent the waste of the light which falls below the lens. This application of totally reflecting prisms is claimed by Mr. Alan Stevenson, of Edinburgh.

There are four orders of lens lights, according to the range of visibility, determined by the volume and brilliancy of the flame; the first order corresponding to the greatest range.

The number of wicks of the lamps, and the dimensions of the whole apparatus, vary, accordingly, in the different orders. The third and fourth orders are subdivided into two classes, corresponding to the larger and smaller size of the apparatus. The dimensions of the lantern of the several orders, the number of wicks of the lamps, and other details, will be found in the table annexed.

Fixed and revolving white lights are used to give six characteristic combinations—the simple fixed light; the fixed light varied by bright flashes every four, three, or two minutes; the revolving light with intervals between the flashes, or between the eclipses, of a minute or half a minute. By introducing a red fixed light, alternate red and white flashes, and a fixed white light with red flashes, these combinations are extended to eight. Two fixed white lights, in separate towers, are used in a few cases for the sake of distinction.

The loss of light by a deep-red glass is stated by Mr. Stevenson to be as high as eighty per cent. of the whole. A pink French glass absorbed but fifty-seven per cent., but the color of the burner was not very decided.

All parts of the illuminating apparatus for light-houses are supplied from a depot and workshops under the immediate direction of the secretary of the light-house board.

The distance to which a light may be seen, its range of visibility, (called sometimes simply its range,) depends upon the brightness (intensity) of the light, its elevation above the general surface, and the greater or less transparency of the atmosphere. Some persons, too, can distinguish lights at a much greater distance than others. The
range of a light, then, is not a sure test for comparing it with other lights.

The value (useful effect) of a light depends on its brightness and the extent of the horizon which it will illuminate. The brightness can be ascertained by experiment with the photometer, in terms of the light of a standard lamp as a unit; the extent of horizon illuminated, by simple measurement in degrees, minutes, and fractions. Hence the value of a light can be expressed in numbers: so many units of the standard lamp, multiplied by so many degrees on the horizon. If the light is not spread uniformly over the horizon, it is necessary to estimate its brightness at different parts, and the space over which it extends. The value for each portion being thus found, the whole value is easily deduced.

Theory will show how much of a light from a lamp can be thrown by a given lens, or mirror, in a particular direction; but as the degree of perfection of these instruments would vary the result considerably, recourse is to be had to experiment in comparing different kinds of illuminating apparatus. Very careful and often-repeated experiments have been made by M. Léonor Fresnel, late secretary of the light-house board of France, for the purpose of comparing the reflector and lens lights used in France. To appreciate them fully, it is necessary to follow the very minute details entered into, by measuring the brilliancy of the light in the various divisions of the horizon, and finding its total value, (useful effect,) in estimating the value from different parts of the apparatus, and the allowance to be made for loss of light from the construction of the lantern, &c.* Without such a scrutiny, however, the character of their author, as an experimentalist, is a guarantee for the accuracy of the results. They show the following comparison for lens lights of the different orders, and equivalent systems of reflector lights:

4th order, second class—economy $2\frac{1}{4}$ to 1 in favor of the lens light.
3d order, first class—economy $3\frac{1}{2}$ to 1 in favor of the lens light.
2d order, fixed—economy $3\frac{1}{2}$ to 1 in favor of the lens light.
2d order, revolving—economy 4 to 1 in favor of the lens light.
1st order, fixed—economy 4 to 1 in favor of the lens light.

This table is given more in detail in the Appendix M, No. 8. The combination of reflectors, to be equivalent to the first-order lens, is such as has never been made. The average economy of the light itself is about $3\frac{1}{2}$ to 1 in favor of the lens system.

To render these deductions strictly applicable to practice, they should be made under the precise circumstances in which the apparatus is used; but as they would then be made in conditions unfavorable to accuracy, it is usual to assume that, in practice, the lamp is burning in the best way, and thus to make the comparisons. To render them strictly applicable to the lights of the United States, the oil, too, should be the same, and the manner of burning it the same; or, if different oils were used, each oil should be burned under the most favorable circumstances for it. These remarks, however, touch only the refinements of the case, and show the desirableness of experiments made with the actual reflectors,

*See report of Lieutenants Thornton A. Jenkins and Richard Bache, U. S. Navy, to the Secretary of the Treasury, 1845.
lamps, and oil in use in the United States, with the lenses and their lamps, the oil being the same.

The board proposes to make such experiments, and has obtained the sanction of the Treasury Department for so doing. In the meantime it will be quite safe to assume, in any comparative calculation, the results just stated, which, indeed, agree remarkably well with those of Mr. Stevenson for the Scottish lights.

The question of the relative economy of the lens and reflector lights, depends upon the relative cost of the light-house adapted to them; of the illuminating apparatus; of the repairs of the building and apparatus; salaries of the keepers; cost of the oil, and incidental expenses. In France two keepers have always been employed for the larger lights; one or the other being required to be constantly on duty, so as never to leave the lights without attendance in the lantern or watch-room. With the new apparatus for the first-order lights, in ordinary cases, three keepers are allowed, increasing the expense for salaries about one-fourth. With those of the other orders, there has been no increase, two keepers being allowed to those of the second order and third order, first class, using the mechanical lamp; and one to the third order, second class, and to the fourth-order lights, using the ordinary fountain lamps with Argand burners. The light-house buildings are of the same cost, except that an additional room must be provided for the third keeper of the lens lights of the first order. The first cost of the lens apparatus is somewhat greater than that of the mirrors; but the great economy in the consumption of oil turns the scale entirely in favor of the lens lights; giving, according to the calculations of M. Fresnel, made upon the prices in France,* for a small light, an economy of nearly two to one in favor of the lens; and for a large light, (revolving light, second order,) an economy of more than one and a half to one. The interest on the first cost of apparatus, and the additional salaries, must make a large increase to counterbalance the large economy in the consumption of oil, which, in France, we have seen to be more than three to one in favor of the lens lights.

The same grade of intelligence and education is stated by M. Fresnel to be required in the keepers of the two kinds of lights. The care of the mechanical lamp, however, requires more mechanical tact than that of a common lamp; while the cleansing of the lens apparatus requires less time and care than the others.

The additional keeper of the large lights, and the providing of a second lamp in case of accident, is supposed to guard against the danger of the total extinguishment, for any considerable time, of the single lights, which is the weak point of the lens system. A very simple alarm is also provided, which, as soon as the overflow in the lamp ceases, rings a bell, giving notice of any derangement in the machinery, &c., for raising the oil. Mr. Stevenson causes this apparatus to keep a bell constantly sounding, and to stop when the machinery becomes deranged; believing that he better secures the watchfulness of the keeper thereby. On this question M. Fresnel gives this very decided opinion—after an experi-

---

* Report of Lieutenants Jenkins and Bache, pp. 122, &c.
ence of twenty-two years, sustained by the daily results of more than one hundred lenticular lights of the first three orders—"that they have been distinguished by the regularity of their service."

The metallic parts of the lantern are made by gun-metal, (bronze,) the astragals being inclined to the vertical. The ventilation of the lanterns is carefully attended to. The domes are of copper, painted white inside. There is a lightning conductor, of copper-wire strands, twisted like a rope, to each tower. The keeper's house, and the cellars for oil, are generally detached from the light-house, when practicable.

The construction of light-house towers offers nothing for special remark, except that, as might be expected from the care used in obtaining plans for them, they are substantial and convenient, dry and well ventilated.

Oil of colza, (rape-seed,) expressed from the seeds of a kind of wild cabbage, (brassica oleracea,) is the only oil used in the French light-houses. The colza gives a very white light, and the oil does not readily thicken by cold.

M. Reynaud, secretary to the light-house board of France,* speaks of the results of comparative experiments on olive oil, mineral oil from bituminous schiste, hydrogen, and mixtures of oxygen and hydrogen, as having been unfavorable.

The oil is tested before being received, by burning for fifteen or sixteen consecutive hours in a mechanical lamp, when, if it burns clearly, and makes little or no crust on the wick, it is received. The olocmeter is also used in the inspection.

At the principal ports a book is kept, in which masters of vessels may register their complaints in reference to the lights on the coast. Their remarks are examined, and inquiry made by the inspecting engineers.

Table of comparison of lens and reflector lights, for the experiments of M. Léonor Fresnel.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number. Diameter. Inches. 2 to 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>Second class</td>
<td>+2 13\frac{1}{2}</td>
<td>2 to 1</td>
<td>2\frac{1}{2} to 1</td>
</tr>
<tr>
<td>Third</td>
<td>First class</td>
<td>14 11</td>
<td>1.4 to 1</td>
<td>3\frac{3}{4} to 1</td>
</tr>
<tr>
<td>Second</td>
<td>Fixed</td>
<td>34 20</td>
<td>1.2 to 1</td>
<td>3\frac{1}{2} to 1</td>
</tr>
<tr>
<td>Second</td>
<td>Revolving</td>
<td>24 20</td>
<td>4 to 1</td>
<td>4 to 1</td>
</tr>
<tr>
<td>First</td>
<td>Fixed</td>
<td>36 24</td>
<td>4 to 1</td>
<td></td>
</tr>
</tbody>
</table>

GREAT BRITAIN.

The administrative part of the British light-house system is so peculiar, having grown up irregularly with the expansion of commerce, that

---

* Communication to Lieutenant Jenkins, &c.

1 Sidereal or Bardier Mareet reflectors.
it does not require to be described in detail. The chief English lights are under the direction of the corporation of Trinity House, Deptford Strond, London; and the Scottish and Irish lights under commissioners. The expense of the lights is paid by dues collected from vessels of all nations, including England herself.

The British lights are divided, according to their power and position, into three classes—sea-coast, secondary, and harbor lights.

Each district in England has a local inspector, and the members of the Trinity House corporation also inspect from time to time. In Scotland, the engineer of the commissioners has the general superintendence of the lights.

Notices in regard to lights are given in several of the daily metropolitan papers, in periodicals perused by nautical men, and are posted at the custom-houses.

The lights of Great Britain are principally still reflecting lights, but the lens light has been introduced in many of the most important positions, and is gradually taking the place of the other.

| Trinity House lenses, 1st order | 15 |
| Do. do. 2d do. | 5 |
| Do. do. 4th do. | Number not known. |

In Scotland, the proportion of lenses to reflectors is greater than under the Trinity House corporation.

Mr. Stevenson says: "The Board of Northern Light-houses are, excepting in a few cases, giving up the use of reflectors, and substituting either Fresnel or holophotal lights." (See letter of Oct. 15, 1851.)

Quite recently three new lens lights have been established in England, by the Trinity House Board; three others of the first, second, and fourth orders, respectively, have taken the place of reflector lights; and fourth-order lenses have been introduced for harbor lights.\(^*\)

The first lens light in Great Britain was established in 1835, at Inchkeith, near Edinburgh, under the charge of Mr. Alan Stevenson; the next at the Isle of May; and now the Scottish lights of the larger classes are gradually being converted into lens lights. The Trinity House, of Deptford Strond, introduced the first lens light in England, in 1837, at Start Point, in Devonshire.

Mr. Herbert says: "The hydraulic lamp is universally in use in the dioptric lights of the corporation of Trinity House, with one exception, (the South Foreland light,) where the light is shown from a Carcel lamp, the disadvantage arising from the use of which is the occasional derangement of the machinery."\(^{†}\) In Scotland, the mechanical lamp is used with the lens lights.

When the ventilation of the towers is not complete, the introduction of Professor Faraday's ventilating tubes over the chimneys of the lamps has been found very useful. The consumption of oil is increased, but the light is also increased, and no flickering of the lamp can occur in

\(^*\) Letter of Jacob Herbert, Esq., secretary Trinity House board, London, &c., 1851.
\(^{†}\) Letter from Jacob Herbert, Esq., secretary Trinity House board, &c., to Lieutenant T. A. Jenkins, secretary Light-House Board, United States, 1851.
the highest wind. These tubes are used in all the English light-houses under the Trinity House board.*

The oil of colza is now *exclusively used in all the lights under the Trinity House board.*† According to Mr. Stevenson, its light is a little more intense than that of spermaceti oil; the consumption for a given quantity of light about the same, whether the two be compared in a mechanical lamp or a common Argand lamp; it remains fluid at temperatures which would thicken spermaceti oil; the flame appears more steady, and hence the breakage of lamp-glasses is less than with spermaceti oil. It is furnished in England at eighty-nine cents per gallon, which is forty per cent. less than the cost of spermaceti oil there.

The supplies of oil, wicks, glasses, &c., are delivered once a year by a vessel belonging to the corporation.

There are two distinctive characters given to the reflector lights on the Scotch coast, differing from those already adverted to; in one, by placing the rims of all the mirrors on one side of a revolving light, in one vertical plane, and inclining their axes slightly to the horizon, and causing a rapid rotation of the frame, a flash is produced every five seconds, which appears to rise and fall; the bright and dark intervals follow each other rapidly. In the other, an intermittent light is produced by the vertical motion of circular disks in front of the reflectors, eclipsing the light for half a minute, and then permitting it suddenly to show out.

In England, the cost of the lens apparatus for a sea-coast light, lantern, and pedestal, exceeds that of the reflector apparatus nearly one-fourth; but this disappears in the cost of tower and apparatus, and the advantage is on the other side when the charge for construction is turned into an annual interest, and the cost of illumination is considered.

No difference is made in the number or salaries of the keepers of the lens lights in England. Two keepers are allowed to all large lights, because one is required always to be on duty in the watch-room.†

Comparing the value (useful effect) of the revolving lens light at Skerryvore, Scotland, with the old reflector light at Inchkeith, Mr. Stevenson makes it in the ratio of nearly $8\frac{1}{2}$ to 1, and the economy (economical effect) in the proportion of $3\frac{1}{2}$ to 1. Spermaceti oil was used in these comparisons, the result of which, as to economy, is the same as was obtained in France. In the comparison of fixed lights, Mr. Stevenson makes the economy of the lens light rise to four times that of the reflector. Taking the interest on first cost of erection as an annual charge, and combining it with the cost of maintaining the two kinds of lights, Mr. Stevenson makes the economy of the lens system, for *revolving lights of the first order*, to be as 1.2 to 1, and for large fixed lights as $1\frac{1}{2}$ to 1.§

Argand burners and parabolic reflectors are used in the British light-vessels, both for fixed and revolving lights. The lanterns are of copper, or of gun-metal.

There are from three to eleven light-vessels in each of the districts

---

*Letter from Jacob Herbert, Esq., secretary Trinity House board, &c., to Lieutenant T. A. Jenkins, secretary Light-house Board, United States, 1851.
†Ibid.
‡Letter from Jacob Herbert, Esq., to Lieutenant Jenkins.
§Stevenson's Skerryvore Light-house and Illumination of Light-houses—1848.
under the charge of the Trinity House board, and in each district a relief light-vessel is stationed. A gong is used as a fog-alarm, in the Trinity House corporation light-vessels.

The very ingenious apparatus invented by Mr. Thomas Stevenson, and called, from its rendering the whole of the light effective for illuminating purposes, "holophotal," will be found described in the Appendix P, No. 2. A holophotal apparatus may be made entirely of glass, being composed of totally reflecting prisms, and of lenses. The hemisphere of rays thrown behind the light is reflected totally by a series of zones, the surfaces nearest the flame forming a dome, of which the flame is the centre, and, therefore, not altering the direction of the reflection. The rays thus reflected forwards are received by the same lens and totally reflecting prisms, which give the appropriate divergence to the rays thrown forwards from the lamp.

The lens system was early introduced into Holland, where it has been entirely approved; it has also been introduced into Sweden, Denmark, Prussia, and Russia. The colza oil is also in common use. There is no case where the lens lights have been introduced, in which recurrence has been made to the reflector system.

From these data, we are prepared to make the comparison required by the instructions of the Department, under the heads which it has pointed out, as far as it can be done without further experiments.

The use of these data will be perfectly safe, since the systems of reflecting and refracting are compared under the most favorable circumstances for each class.

1st. Useful effect.—We have just shown that, by the experiments of Fresnel and Stevenson, the useful effect of a lens light is to that of a reflector light of the same class, on the average, as $3\frac{1}{2}$ to 1; of course, the holophotal system of saving some of the lost light in the various arrangements, increases this disparity.

2d. Economy; first cost; repairs; durability; efficiency.—This branch of the subject has been so elaborated elsewhere in this report, that it is considered only necessary to remark briefly upon it in this place.

Assuming that the lights in the two systems are the best of their kind:

The economy of the third-order lens light, in comparison to the reflector light, as nearly equal to it as possible, is as 1 to 2.6. That is, it requires more than two and a half times as much oil, &c., for the reflector light, which is less than one-third as useful as for the lens light.

The economy of the second-order lens light, in comparison to the reflector light, as nearly equal to it as it is possible to be made, is as 1 to 4.07. That is, the lens apparatus is four times as advantageous as the reflector light.

The economy of the first-order lens light, compared to that of the reflector, is 4.08 to 1; or that the reflector is four times as expensive as the lens, or that the lens is four times as advantageous as the reflector light.

"That if we take into account the first cost of construction and the expense of their maintenance, we will find, in respect to the effect pro-
duced, the new system (dioptric) is still from one and a half to twice as advantageous as the old."

The repairs to the mechanical lamps employed in lens lights, amount to a mere nominal sum.

No difficulty can be anticipated in getting proper keepers to attend to the lens lights. Men belonging to the class of ordinary mechanics, or laborers, are appointed to take charge of the lights in France. Eight or ten days will suffice to instruct a light-keeper in the most essential parts of his duty, receiving lessons from an instructor conversant with all the details of the service.

The attendance upon the lamps can no longer be regarded with fear of ill consequences. They have been greatly improved, and are now believed to be nearly perfect.

There is nothing belonging to a mechanical lamp which could not be repaired by a watchmaker, and any person capable of taking charge of a movable light is equally competent to manage a lens light.

While experience has fully proved that the fears which were entertained of the extinction of the single lamp used in the lens lights are illusory, yet, should they still exist in any mind, and greater guarantee be absolutely required than experience gives, it would be easily afforded by furnishing each of the three or four wicks of the mechanical lamp with a separate pump, rendering them thus, in effect, three or four lamps. By subdividing the wicks, this might, if desired, be carried still farther, and the expense of the additional pumps would not add two dollars per annum to the cost of each first-class light.

The experience in relation to lenses has not been confined to any one country; even in our own, with but three stations, the results are most conclusive in their favor.

The board is of opinion that every first-class light should have two keepers, as in Great Britain, &c. Such, however, is not the case in the United States; and in making the comparison of cost, they have deemed it best to allow the salary of an assistant keeper, and the additional cost of his dwelling-rooms, in making comparative estimates of the expense of the lens and reflector lights; but in comparing the actual annual expense of lights per lamp in this and in foreign countries, no credit was given to the foreign light for having additional keepers, and no charge made to our lights for deficiency of keepers.

The Committee on Commerce (Mr. J. C. Clarke, reporter, May 25, 1842, H. R. No. 811, 2d session 27th Congress) say:

"It is not believed that dioptric lights of the first order can be required at any point except a few, and those the most important outer sea-stations. The remark hereinafter made in regard to the comparative efficiency and economy of French and American lights, and the letter of the Auditor, may suggest doubts of the propriety of using any of the first order."

First-order lights are, if possible, more necessary on our coast than on that of any other country, and the board cannot, therefore, conceive what good reason could be given for not introducing them. It is true, we have no first-order lights at present, but many are claimed to be of that class, while they are no better than third-class ones. It is demonstrated elsewhere in this report, that the first-order lenses are absolutely necessary;
and it is beyond question true, that no combination of the reflectors can produce a first-order light equal in power to a first-order lens.

Again, the committee say:

"In arranging lights, useful effect and expense should be looked at in one view. An outer or sea-coast light should have a 'portee' or reach of light sufficient to give the approaching vessel, in all weathers, timely notice of danger. Any expense in fitting up lights to produce more effect is useless. A light extending its limit of visibility to the distance of twenty-five miles, is as efficient and useful as one of greater range. The mariner sees it in ample time to shape his course, free from all difficulty." The board concur in these opinions. But our lights are not of that character. The object of a light is to warn the navigator of some hidden danger, or of his approach to land, and to guide him clear of that danger on his way, or into his destined port. It therefore becomes necessary to regulate the power and range of a light, solely with reference to those primary objects. If a light is placed on a "clear coast" merely to warn the mariner of his approach or proximity to a lee-shore, or of his danger of running his vessel on it at night, a power and range must be given with reference to the gradual or irregular soundings in approaching the danger. If it is intended to serve as a guide around a dangerous point or shoal, then it becomes necessary to give it such a range as will insure safety to the vessel outside of these dangers under every circumstance; such, for example, as a sudden storm, or a continued gale blowing on shore for many days.

There are many points along the coast of the United States, with dangerous shoals extending many miles from them. To guide vessels clear of these dangers, lights of the greatest power and range are indispensable. Take, as example, the Nantucket shoals, those between Barnegat and Cape May, off Absecon, and those off Capes Hatteras, Lookout, Fear, Romain, &c. The shoals off Cape Fear extend twenty nautical miles from the present light, which can only be seen under favorable circumstances about twelve miles. The necessity for first-order lights at all points where sea-coast lights are required, is therefore indisputable. None of the lights named above have a sufficient range to warrant the mariner in running boldly for them. The lights on the Bahama banks are vastly superior to those on the Florida coast. The idea that our lights are injured by the haze, mists, &c., arising from the proximity of our southern coast to the Gulf stream, is therefore erroneous. That there is nothing in the atmosphere along our coast calculated to effect the brilliancy and power of good lights, which does not exist on the coasts of England, Ireland, Scotland, France, Holland, Denmark, Norway, Sweden, &c., is abundantly proved by the observations of intelligent individuals, who are acute observers of meteorological phenomena, and who have had their attentions drawn to this particular subject in consequence of the great inferiority of our lights, compared to those of the rest of the maritime world.

The proper elevation to be given to first-class lights, is a subject closely allied to, and in some degree dependent upon, the general state of the atmosphere in the vicinity of the particular lights.

Observation by intelligent professional persons, will always enable the
light-house engineer to act understandingly and decide correctly in all special cases of this kind.

As a general rule, it is considered by able light-house engineers in Europe, that on coasts where fogs prevail, a light should not have a greater elevation than 200 feet above the mean sea-level; but under other circumstances any elevation, if desirable to afford a greater range to the light, may be given, which is not above the region of clouds.

**RELATIVE ECONOMY OF REFLECTOR AND LENS SYSTEMS.**

Cost of the gradual introduction of the Fresnel or of the Holophotal system, carefully ascertained and compared with the present system, say in a period of five or six years, in regard to useful effect and economy.

For this purpose let us commence by taking Sandy Hook light, fitted with 18 twenty-one inch reflectors, found by comparison with the Navesink lens light of the second order, in the proportion of 1 to $6\frac{1}{2}$ in useful effect.

Reported consumption of oil, 1850, (Senate Doc. No. 14, 2d session 31st Congress). ................................................. 661 gallons.

Reported consumption to Light-house Board, (see notes of inspection, 1851,) 195 gallons per quarter .................. 780

United States estimate .................................................. 630

European estimate ...................................................... 720

The mean of the keeper's reports for two years is the European estimate within half a gallon ............................... 720\$2

Take, then, as a just quantity, 720 gallons per annum.

By placing a second-order lens light in the Sandy Hook tower, which could be done without increasing the dimensions of the lantern or elevating the tower, there would be a saving of 336 gallons (or 720–384) of oil per annum, which, at $1 30 per gallon, will be $436 80. Supposing that the other supplies would be in the proportion of 1 to 18, and making a proper allowance for the difference in the price of the glass chimneys for the lens lights, omitting cleaning-rags, &c., upon which there would be undoubtedly a great saving, there would be an additional saving of $22 78 per annum, or a total saving by the change in one year of $459 58, with a lighting apparatus which would never require repairs, and cannot wear out; of a power six and a half times greater than the present reflector apparatus, which requires to be renewed frequently—say once in ten to fifteen years, at least.

The economical effect will be, for reflector, as at present...... $964 35

The economical effect will be, for lens ................................. 504 77

or nearly as two to one.

All first and second-class lights, whether lens or reflector lights, require two keepers. An additional keeper, at $360 per annum, would nearly cover the saving in money, it may be said; but still, the sum paid to the present keeper, above that allowed to other keepers, would be saved, as the necessity for this increase would cease the moment a proper keeper is appointed as an assistant; or, $150 + $99 58 = $249 58. Thus we
should have a light six and a half times better than the present one, fitted with an imperishable apparatus, save $249.58 in money per annum, besides the price of eight extra burners complete, and eight extra outside burners, left last year, (the cost of which is not known,) and have a competent keeper always in attendance upon the light at night.

The same comparisons may be made with Cape Henlopen, Cape Henry, and Cape Hatteras lights, with the difference that first-order lenses are required at these very important points. Cape Hatteras, the most important one, having only fifteen, while the other two have eighteen reflectors each, consume, respectively, 720, 720, and 600 gallons of oil when properly kept. A first-order lens light consumes 570 gallons of oil, making a saving of 330 gallons in these three lights.

It has been seen that the third-order lens light at Brandywine shoal, having a range of less than sixteen miles, elevated forty-five feet, and seen from an elevation of ten to fifteen feet, is six times more powerful than the Cape Henlopen light.

The estimated value of useful effect of a third-order lens, larger model, similar to the one at Brandywine shoal is.... 1,400,000
Which has been shown to be six times better than Cape Henlopen light; therefore, the value of useful effect of that light is................................................................. 233,333
And the value of the light proposed as a substitute (first-order lens) is................................................................. 9,500,000
Therefore, the new light, consuming 150 gallons less oil per annum, will be forty-seven times more useful; or seven times more useful than the third-order lens, already shown to be so far superior to it.

The same comparisons might be continued to the end of the list of our lights.

It may be useful to compare a few of the smaller lights; and, as an example, the Lazaretto light, near Baltimore, may be taken. There are eleven lamps and spherical reflectors in this tower.

Reported consumption last year, 431 gallons of oil.

Estimated consumption according to European standard... 440 gallons.
United States estimates................................................. 385

This light is required to light a harbor, and the entrance to it, of small extent: a visibility not exceeding five to six miles.

The first cost of the eleven lamps and reflectors, (which require to be renewed frequently,) frame, fitting, &c., independently of spare lamps, burners. &c., will be not less than......... $350.00
Annual expense for oil, 431 gallons, at $1.30.................... 560.30
For chimneys, glasses, and wicks.............................. 12.30

Extra burners, supposed not less than ......................... 5.00

Annual cost............................................................. 577.60

independent of cleaning-powders, rags, &c., not required for a lens light.
The first cost of a sixth-order lens apparatus, which does not require to be renewed, with three lamps, (two being extra,) and pedestal, &c., complete, estimating five francs to $1, will be .............................................. $252 00
Which is less than the first cost of the reflector light, by..... 98 00

The consumption of oil per annum for the lens light will be forty-eight gallons, costing.............................. $62 40
For wicks and chimneys, say................................. 1 50

63 90

Thus, while the first cost of a sixth-order lens apparatus, producing a far better light than the Lazaretto light near Baltimore, is $252, and the first cost of the present light is not less than $350, or in the proportion of 1 to 1.39, the annual expense is as $63 90 for the lens, to $577 60 for the reflector light—in the proportion of 1 to 9; or, in other words, the present inferior reflector light costs nine times more, annually, than the sixth-order lens superior light would.

The comparison may be made with other lights of this class more recently erected.

The two beacon-lights on Oak island, (Cape Fear,) built last year, are fitted with ten spherical reflectors and lamps each.

The apparatus for these two lights cost not less than............ $700 00
The annual expense for oil, &c., exclusive of extra burners, &c., is not less than........................................... 1,070 00
Two sixth-order lens lights would cost, with extra lamps, &c., complete.......................................................... 504 00
Annual expense for oil and wicks, glasses, chimneys, &c..... 127 80

The proportion in favor of lenses, in this case, will be $504 to $700 in first cost, or 1 to 1.39; and in annual expense $127 80 to $1,070, or 1 to 8.14; making the present reflector lights, annually, 8½ times more expensive than the lens light would be at a large first cost, and produce far better lights.

The same comparison might be made with the two beacon-lights at Price's creek, (Cape Fear river,) recently erected, and pretty nearly the same results would be had.

The revolving light at Ocracoke, fitted with ten twenty-one-inch reflectors and lamps, might be advantageously changed to a fourth-order lens light.

First cost of reflector apparatus not less than $950 to $1,000, say ................................................................. $1,000 00
First cost of a fourth-order revolving lens light with revolving machinery, &c., and three lamps complete, (two being extra,) 5,005 francs.............................................. 1,001 00

The first cost of the two may be considered, therefore, equal, while the superiority of the lens is undoubted.
The reflector light consumes, as reported, (see Ex. Doc., No. 14, 2d session 31st Congress,) 467 gallons of oil per annum:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube-glasses and wicks</td>
<td>$13</td>
</tr>
<tr>
<td>Spare lamps, about</td>
<td>$1</td>
</tr>
<tr>
<td><strong>Making annual expense for supplies</strong></td>
<td><strong>$631.30</strong></td>
</tr>
</tbody>
</table>

The consumption of oil for the lens will be 130 gallons, at $1.30 per gallon:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube-glasses</td>
<td>$1.25</td>
</tr>
<tr>
<td>Wicks</td>
<td>$0.50</td>
</tr>
<tr>
<td><strong>Total annual expense for supplies</strong></td>
<td><strong>$171.95</strong></td>
</tr>
</tbody>
</table>

Thus it is seen that, while there is no difference in the first cost of the apparatus, the lens which never requires renewing, while the reflectors will not last usefully for more than ten to fifteen years, the lens will produce a much better light, and economically, in the proportion of $171.95 to $631.30, or 1 to 3.7 per annum. That is, the inferior light, costing the same amount at first, is nearly 3 1/2 times more expensive annually than the better light.

If it were necessary, these comparisons might be extended; as there are many of the bay, river, and harbor lights fitted with ten, twelve, and fifteen lamps and reflectors, which might, with great propriety, be changed to lens lights of the fourth order, if not, as it is believed, many of them might be changed, with propriety, to fifth and sixth-order lights.

The light-tower with thirty lamps and parabolic reflectors, which is not equal to a second-order lens apparatus for the upper, and the fourth order, larger model, for the lower light, in the same tower, may be stated as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption of oil for second-order lens</td>
<td>384 gallons</td>
</tr>
<tr>
<td>Consumption of oil for fourth-order lens, (larger model)</td>
<td>130</td>
</tr>
<tr>
<td><strong>Total for the two lights, greatly superior to the reflector lights</strong></td>
<td><strong>514</strong></td>
</tr>
</tbody>
</table>

Estimated consumption in the United States, per Argand lamp, 35 gallons; for 30 lamps | 1,050 gallons.
Estimated consumption in Great Britain, where properly kept, 40 gallons per lamp | 1,200 gallons.

Making a difference in the saving of oil in this tower, of 30 lamps, of 536 gallons per annum, according to the United States estimate, and 686 gallons according to the European estimate, which is believed to be nearest the truth, (judging from the returns of our own keepers,) where the lights are properly kept. Supposing the oil to cost at the light $1.30 per gallon; in the first case there is a saving of $696.80, and in the latter case $891.80. This light having an assistant keeper, no additional
expense for keepers would be incurred by substituting the lens apparatus.
But as this is an important sea-coast light, it should be fitted with a lens
of the first order.
The consumption of oil for a first-order lens is per annum
570 gallons. ........................................ 570 gallons.
The consumption of oil for a reflector light, as nearly
equal to a first-order lens as it is possible to obtain one,
(36 lamps,) at the estimate of 40 gallons per lamp per
annum, will be........................................ 1,440

Making a difference, in the annual saving of oil alone of... 870

Careful photometric experiments have proved that a first-order lens is
four times as economical as a reflector light of 36 lamps and large para-
abolic reflectors, and that the best reflector lights seldom equal the second-
order lens lights.

Thus, by substituting a lens of the first order for a reflector of the
first order, there would be an advantage of 4 to 1, and the saving of oil
alone, at the supposed rate of $1.30 per gallon, delivered at the light,
of $1,131 per annum.

But, to carry the comparison still further: suppose it is necessary to
have the present distinction of two lights in the tower preserved, and at
the same time a first-order lens for the upper light, and a fourth-order,
larger model, for the lower one.

It has been shown that the thirty lamps consume per annum, accord-
ing to the United States estimate, 1,050 gallons, and by the European
estimate 1,200 gallons of oil.

The first-order lens will consume ................................. 570 gallons.
The fourth-order lens, larger model.......................... 130
Making a total consumption for the two lights of 700 gallons per annum.
Difference between the present light (inferior to a second and fifth-order
lens) and the first-order and fourth-order lens, taking the smaller esti-
mate of this country, will be 350 gallons of oil; or, according to the
European estimate, to 500 gallons of oil; and in money, $455 or $650
per annum, and the useful effect of the light will be in the proportion
of about 1 to 10.

The light of twenty-nine lamps, which is not equal to a second-order
lens, consumes, as estimated in this country, 1,015 gallons of oil per
annum, and according to the estimate in Europe 1,160 gallons per annum.

A second-order lens light consumes 384 gallons per annum, making a
saving in that article alone of 630 gallons, according to one estimate, and
776 gallons per annum according to the other estimate; or in money,
$820 30, or $1,008 80.

The difference in the intensity and usefulness of the light would be,
assuming the reflector light to be unity, 1 to 4; or, in other words, the
lens light would be four times as advantageous as the reflector light.
But, in this case also, it is important that a first-order light should be
substituted for the present one. Therefore, the consumption would be
570 gallons for the first-order lens, instead of 1,015 or 1,160 gallons for the present light, making a saving of 445 gallons, or 590 gallons; or in money, $578.50, or $607.70 per annum. This being one of the lights on the coast of the United States with an assistant keeper, no increase of expense would arise in that department.

There is a light with twenty-one lamps and reflectors, inferior to a second-order lens, which ought to be changed to a first-order lens.

Present estimated consumption, United States.................. 735 gallons.
European estimate.......................................................... 840
Second-order lens consumes............................................. 384

Difference in favor of lens, 351, or 456 gallons per annum; and in money $458.30, or $592.80.

Here, also, a first-order light should be substituted, for which 570 gallons of oil would be required, while the present inferior apparatus consumes 735 or 840 gallons per annum; making more than a sufficient difference in favor of the lens to pay the salary of an additional keeper, while the first-order lens light would be from five to six times more advantageous to commerce than the present one.

The remaining reflector lights would be greatly improved in brilliancy and useful effort by changing them all to lens lights. The consumption of oil for the 311 reflector lights, containing 2,880 lamps, according to the Department estimate, would be..................... 100,800 gallons.
According to the European estimate it will be........... 115,200
Say at a cost, delivered at the lights, of..................... $131,040 00
Or.............................................................. 149,760 00

It has been shown elsewhere in this report that the twelve best reflector lights of the United States are not equal to the second-order lens lights; that there are ninety not equal to the sizes of third-order lenses; and two hundred and five not equal to the fourth, fifth, and sixth orders of lenses.

12 lens lights of the second order consume annually of oil. 4,608 gallons.
96 lens lights of the third order consume annually of oil. 17,568
205 lens lights of the fourth, fifth, and sixth orders consume annually of oil................................. 9,840

Total amount of oil necessary for all these lens lights... 32,016
The four lens lights consume now.............................. 1,518

Total for all the lights....................... 33,534

Present quantity appropriated for the lights of the United States in 1851-'52......................... 108,255 gallons.

United States estimate for reflector lights actually in existence, 2,880 lamps................................. 100,800
European estimate for 2,880 lamps.............................. 115,200

Saving in oil by changing to the lens system........... 68,784
Ditto, to European estimate........................................... 83,184
Annual saving in money, adopting the United States
estimate, at $1 30 per gallon delivered.............. $89,419 20
Ditto, on the European estimate.......................... 108,189 20

Take the quantity estimated for.................. 108,255 gallons.
Deduct for lenses existing now................... 1,518

106,737

Deduct for the 16 fourth-order lens lights, and the 313
of the different orders .................................. 32,816

Will leave a saving of............................ 73,921
Or, in money............................................... $96,105 10

Thus it is seen that instead of 108,255 gallons of oil, as at present
required, the same number of lights, superior in brilliancy and usefulness, in the lens system, could be maintained with 32,816 gallons per annum. Hence there would be a saving in money (taking the mean of the actual quantities according to the United States and the European estimates, which is 75,984 gallons,) of $98,779 20 per annum for oil alone, in favor of the lens system, throwing entirely out of view the cost of the difference of transportation, which would necessarily be in favor of the smaller quantity.

To this actual saving for oil of.......................... $98,779 20
Add the difference in favor of lenses between the cost of
glass chimneys, repairs of lamps, chimneys and wicks, in
the proportion of 309 to 2880, or 1 to 9, in favor of
lenses. The appropriations of 1851-'52 for chimneys
and wicks was $3,129 30; saving with the lenses, of..... 2,816 37
Appropriation for repairs to lamps and reflectors of 1851
and 1852, $12,183, making a saving with lenses, of.... 10,964 70

13,781 07

Total......................................................... 13,781 07
Deduct from this sum the difference in price of glass chim-
neys for lenses, say....................................... 775 00

And there will be a clear saving of..................... 13,406 07
To which add saving for oil............................ 98,779 20

Total amount gained in one year..................... 112,185 27

The estimates for whiting, buff-skins, cotton cloth for cleaning-rags, and the amount gained in transportation of a smaller quantity of stores, are retained, under the presumption that little saving in these items would be made by the change.

Having shown that if, at a moment, all the lights on the coast of the United States fitted with Argand lamps and reflectors were changed into lights superior in nearly every instance in point of intensity, brilliancy, and range, to those now in use, by the introduction of the system of
Fresnel, there would be an annual saving in money of $112,185 27, out of an appropriation of $152,081 59, or that the present system of lighting is more expensive than the Fresnel system in the proportion of 3.8 to 1; or, in other words, while the annual expenditure for oil, wicks, chimneys, cleaning-rags, repairs of illuminating apparatus, &c., as at present, amounts to $152,081 59, if all the lights were fitted with the Fresnel apparatus, of equal in all, and in many cases greater power, than at present, the annual expense would only be $39,896 32.

This annual saving of $112,185 27 would be sufficient to enable the Government, in five or six years, to have every light on the coast fitted with the lens apparatus, without costing one cent beyond the customary appropriations up to that period, and thenceforth to insure an annual reduction of the light-house expenditures for those stations to the amount stated.

In this estimate no allowance has been made for the value of the present apparatus; an item of considerable importance.

The wear and tear of the reflectors, which require to be renewed frequently, and the large expense of keeping the lamps and burners in repair, is at once got rid of; the proportion being, as has been already shown, in the ratio of 1 to 9. While reflectors require renewing, the lenses, in the language of Sir David Brewster, "are perennial. If mere considerations of economy were to be taken into view, and the great cause of humanity and the interests of commerce to be thrown aside, it will suffice to say, that the first year's saving would fit up all the smaller river, bay, and harbor) lights of the United States with lenses, which would prove to be the most economical step, as it is especially with these 8, 10, and 12-lamp lights that the smaller lens lights are to be most favorably compared, in an economical point of view; the consumption of oil being in the ratio of about one-seventh, one-ninth, and one-eleventh; whereas in the large reflector lights the saving is from one-fifth to one-half and one-third.

Now, although the most decided results in favor of economy are to be expected from the reformation of the minor classes of lights, we do not, therefore, conclude that we should begin with them, because humanity, and the more general interests of commerce and the safety of our ships-of-war, have their claims. Our ships-of-war, vessels engaged in foreign commerce, all that arrive on our coast from distant voyages, are more liable to suffer from the inferiority of our sea-coast lights, or higher-class lights, than are our coasters, from the deficiencies of the inferior classes; and accordingly, it is along our exterior coast-line that we find occurring the greater number and the most disastrous shipwrecks during the stormy seasons.

The minor lights are usually so multiplied, and the localities inside of the general coast-line so well known to the navigators of our bays and rivers, that they cannot often be at a loss for a secure harbor somewhere in heavy weather; whereas the sea-coast lights, at times comparatively few, and even deficient in number, and at others complicated by their superabundance, occupy positions full of danger to the navigator. It is, therefore, of the first importance to ships arriving on the coast from distant voyages, that the light which they first make should be clearly
visible at the greatest distance from the land, and that it should be so distinct in character as not to be confounded with other lights; and it is not less important that we should not delay giving to such lights all the perfection they are capable of receiving; and having accomplished this purpose with respect to the most prominent and important, we should extend the improvement to the lights of inferior classes and of minor importance, although by so doing we were to save at the outset something less than if we were to begin by reforming the minor lights, because in the meantime our foreign commerce and the Navy might be suffering to an amount far surpassing that which might be saved to the revenue.

Mr. Alan Stevenson (Treatise on Light-houses, page 121) says: “In comparing the fixed dioptric and the fixed catoptric apparatus, the results may be summed up under the following heads:

1. It is impossible by means of any practicable combination of paraboloidal reflectors to distribute round the horizon a zone of light of exactly equal intensity, while this may be easily effected by dioptric means in the manner already described. In other words, the qualities required in fixed lights cannot be so fully obtained by reflectors as by refractors.

2. The average light produced in every azimuth by burning one gallon of oil in Argand lamps with reflectors, is only about one-fourth of that produced by burning the same quantity in the dioptric apparatus, and the annual expenditure is £140 8s. 8d. less for the entire dioptric light than for the catoptric light.

3. The characteristic appearance of the fixed reflecting light in any one azimuth would not be changed by the adoption of the dioptric method, although its increased mean power would render it visible at a greater distance in every direction.

4. From the equal distribution of the rays, the dioptric light would be observed at equal distances on every point of the horizon, an effect which cannot be fully attained by any practicable combination of paraboloidal reflectors.

5. The inconveniences arising from the uncertainty which attends the use of the mechanical lamp, are not, perhaps, so much felt in a fixed as in a revolving light, because the greater simplicity of the apparatus admits of easier access to it in case of accident.

* * * * * * * * * *

There can be but little doubt that the more fully the system of Fresnel is understood, the more certainly will it be preferred to the catoptric system of illuminating light-houses, at least in those countries where this important branch of administration is conducted with the care and solicitude which it deserves.”

Mr. Alan Stevenson, the distinguished engineer to the Northern Lights Commissioners, says further:

“The expense of fitting up a revolving light with twenty-four reflectors, ranged on three faces, may be estimated at £1,298, and the annual maintenance, including the interest of the first cost of the apparatus, may be calculated at £418 8s. 4d. The fitting up of a revolving light with eight lenses, and the diacatoptric accessory apparatus, may be estimated at £1,459, and the annual maintenance at £834 10s. 4d. It therefore follows, that to establish, and afterwards maintain, a catoptric light of
the kind called revolving white, with a frame of three faces, each equal in power to a face of the dioptic light of Cordouan, an annual outlay of £63 18s. more would be required for the reflecting light than for the lens light; while for a light of the kind called revolving red and white, whose frame has four faces, at least thirty-six reflectors would be required in order to make the light even approach an equality to that of Cordouan; and the catoptric light would, in that case cost £225 more than the dioptic light."

Convert these two sums into our currency, and it will be seen that we have a saving in the first case of $309, in the second case of $1,089, per annum.

"The effect produced by burning an equal quantity of oil in revolving lights in either system may be estimated as follows: In a revolving light, like that of Skerryvore, having eight sides, each lighting with its greatest power a horizontal sector of 4°, we have 32° (or units) of the horizon illuminated with the full power of 3,200 Argand flames, and consequently an aggregate effect of 102,400 flames produced by burning the oil required for sixteen reflectors; while in a catoptric apparatus like that of the old light at Inchkeith, having seven sides of one reflector each, lighting with its greatest power a sector of 4° 25' we have nearly 31° (or units) of the horizon illuminated with the full power of 400 Argand flames, and consequently an aggregate effect of 12,400 flames as the result of burning the oil required for seven reflectors. Hence the effect of burning the same quantity of oil in revolving lights in either system will be represented, respectively, by \( \frac{102,400}{12,400} = 8.24 \) for the catoptric, contrasted with 102,400 for the dioptic light; or, in other words, revolving lights on the dioptic principle use the oil more economically than those on the catoptric plan, nearly in the ratio of 3.6 to 1."

Let us, then, take the appropriation for oil for the lights in the United States, deducting the quantity used in the four towers fitted with dioptic apparatus, and divide it by 3.6, the proportion to 1, in favor of the lens apparatus.

1851–52.—Appropriation for oil (less oil burned in lens lights) .............................................................. $122,629 25
1 to 3.6 will give necessary quantity for lens lights of equal power ................................................................. 34,063 68

Annual saving for oil by this mode of comparison .......... 88,565 57

Glass chimneys, wicks, and repairs of lighting apparatus, will be in the proportion of not less than 310 to 3,093; that is, 1 to 10.

Amount appropriated for these objects, minus the expenses of the same articles, for the four lens lights ...................... $15,162 30
1 to 10 will give the necessary expense with lenses .......... 1,516 23

Annual saving by this comparison in these articles .......... 13,646 07
The oil being the most bulky article of supplies, it may be assumed that the saving in oil will be a fair proportion for the transportation, the more especially as spare lamps, burners, reflectors, and the great wear and tear of the Argand lamps, burners, and reflectors, is not included in the estimate of annual saving.

Amount appropriated for transportation and delivery of oil and other annual supplies, 1851-'52................. $11,437.00
1 to 8.6 will give the necessary expense for this article... 3,176.94

Annual saving with lenses................................................................. 8,260.06

It may be urged that there would not be so great a saving in transportation by the change; of that, the experiment alone can decide.

By the aid of a small steamer, one-half of the amount appropriated could be saved in money, while very important additional service would be rendered in the way of inspections and more frequent visits to the principal sea-coast lights.

Taking, then, the savings of this mode of comparison, it will be as follows:

For oil in one year................................................................. $88,565.57
For wicks, chimneys, repairs of apparatus, &c................. 13,646.07
For transportation................................................................. 8,260.06

Total annual saving................................................................. 110,471.70

Making within a fraction the same amount which would be saved annually by the introduction of the lens apparatus by this comparison, that was shown by taking the lights in their regular order of powers, and comparing them with orders of as nearly as possible equal powers in the Fresnel system. Nothing, therefore, can be clearer than the results thus set forth.

"The effect produced by the consumption of a gallon of oil in a fixed light, with 26 reflectors, which is the smallest number that can be properly employed, may be estimated as follows: The mean effect of the light spread over the horizontal sector, substituted by one reflector, as deduced from measurements made at each horizontal degree, by the method of shadows, is equal to 174 unassisted Argand burners. If, then, this quantity be multiplied by 360 degrees, we shall obtain an aggregate effect of 62,640; which divided by 1,040, (the number of gallons burned during a year in twenty-six reflectors,) would give 60 Argand flames for the effect of the light, maintained throughout the year by the combustion of a gallon of oil." "On the other hand, the power of a catadioptic light of the first order, like that lately established at Girdleness, may be estimated thus: The mean effect of the light produced by joint effect of both the dioptic and catadioptic parts of a fixed-light apparatus, may be valued at 450 Argand flames; which multiplied by 360 degrees, gives an aggregate of 162,000; and if this quantity be divided by 570, (the number of gallons burned by the great lamp in a year) we shall have about 284 Argand flames for the effect of
the light produced by the combustion of a gallon of oil. It would thus appear, that in fixed lights the French apparatus, as lately improved, produces as the average effect of the consumption of the same quantity of oil over the whole horizon, upwards of *four times* the amount of light that is obtained by the catoptric mode, although in certain directions, opposite the axes of each reflector, the catoptric light is fully 50 per centum more powerful than the dioptic light."

"But the great superiority of the dioptic method rests chiefly upon its perfect fulfilment of an important condition required in a fixed light, by distributing the rays *equally* in every point of the horizon."

Hence, the saving for fixed lights in the same amount of oil, &c., appropriated for as before, will be.................. $91,971 94
Saving on other articles.............................................. 22,226 07

Total saving per annum............................................. 114,198 01

It may, and probably will be urged, that a large portion of this annual saving will be absorbed in the wages of additional keepers. In answer to that, it may be stated, that in the comparisons of reflecting and refracting systems in Europe, the same number of keepers is required for both, of equal class or order, and therefore the ascertained saving is a net annual gain.

In the United States, as a general rule, but one keeper (there being only 14 assistants belonging to an establishment of 301 light-stations, fitted with reflector apparatus) is attached to a light-station. To render the larger, or sea-coast lights efficient and safe, two keepers should be attached to each station having a single tower, and three to those with two towers, whether fitted with reflectors or lenses.

However, as it may be contended, that insomuch as our reflector lights in general have only one keeper, and that the change to the lens system would require two to each light of the first and second classes or orders, it may not be inappropriate to see how many of the present lights on our coast would be required to be changed, and the increased expense for an additional keeper to each. From the northeastern boundary to the Rio Grande there are thirty-eight positions which ought to be fitted with the most powerful first-order lenses.

There are points between some of these first-order lights which ought to be fitted with second-order lens apparatus, making a total of about fifty lights of the first and second order. An additional keeper for each, at the rate of $300 per annum, will be $15,000.

If this sum be deducted from the total already shown, (which, on the contrary, ought to be added to the present expenditures, to render our lights in that department equal to European lights,) there will still be an annual saving of $95,471 70, or $99,198 01. If additional evidence were required to prove so plain a proposition, that the reflector system is *more expensive than the lens system in the proportion of 3.6 to 1*, disregarding the great superiority of the lens system for all the useful purposes of the mariner, it would be found in the action of the Trinity
House corporation, of Deptford Strond, London; Northern Lights Commissioners, of Edinburgh; and the Ballast Board, of Dublin, Ireland.

In 1835 the first lens apparatus was introduced into Scotland.

In 1837 the first lens was introduced into England, under the Trinity House corporation; and since 1845 the first lens light was lighted in Ireland.

Now (1851) there are very few lights fitted with reflectors in Scotland; the commissioners having abandoned the use of that apparatus, and substituted for it the Fresnel and holophotal system of Mr. Thomas Stevenson. (See Appendix.)

The Trinity House (London) has upwards of twenty lens lights of the first and second orders, besides numerous fourth-order harbor lights. Lens lights are also being introduced into Ireland; the precise number, however, now existing there, is not known, as they are not marked in their printed lists, and no information has yet been received from that board.

It is worthy of remark, that these three light-house boards of Great Britain and Ireland, are close corporations, deriving their means entirely from light dues levied upon the shipping of all nations, including that of their own. They derive no pecuniary advantages from the Government, and are only under its general control; consequently their acts are independent of Parliamentary legislation.

If these boards had found the recommendations of the select committee of the House of Commons of 1845, to use less expensive apparatus and combustibles in their lights, with a view to the reduction of light dues, had not been based upon sound principles, they would have had no inducement to follow them; for whether the lights are economically kept or not, good or bad, the same amount of light money would be collected. It is therefore plain that the introduction of the lens apparatus, and the colza oil, into the establishments under the control of these independent corporations, was the result of close examination and trial by those charged with, and most interested in the subject. The introduction after France, first by Holland, and successively by Belgium, Hanover, Prussia, Denmark, Sweden, Norway, Russia, Italy, Spain, Portugal, and Brazil, and the colonies of the respective nations, goes far to counteract any prejudice which may exist in any quarter of the globe against this inimitable illuminating apparatus for light-houses.

Notwithstanding the renovations of English, Scotch, and Irish lights, and the erection of new towers, fitted with the lens apparatus, a material reduction has been made of late years in the light dues levied in Great Britain upon shipping. This may in some degree be attributed to the increased amount of commerce and navigation, and the more frequent and rapid intercourse between nations, by the aid of steam navigation; but, it cannot fairly be contended that it is wholly due to that cause.

These facts are undoubted, and the deductions from them, it is believed, will, upon the closest scrutiny, be found to be correct.

Mr. Alan Stevenson says, (page 115, Treatise on Light-houses:) "It therefore follows, that, by dioptic means, the consumption of oil necessary for between fourteen and sixteen reflectors, will produce a light as
powerful as that which would require the oil of twenty-four reflectors in the catoptric system of Scotland; and, consequently, that there is an excess of oil equal to that consumed by ten reflectors; or 400 gallons in the year against the Scotch system. But in order fully to compare the economy of producing two revolving lights of equal power, by those two methods, it will be necessary to take into the calculation the interest of the first outlay in establishing them."

It is worthy of remark that the French were followed by the Dutch Government in introducing lenses into their light-houses.

The subject of introducing lenses into the Scotch light-houses was brought before the Commissioners of Northern Lights by the engineer* of that body, at the instance of General Colby, of the royal engineers, as early as 1824. The Scotch commissioners directed their engineer to visit France, and report upon the lights of that country. At the close of the year 1834, the board directed lenses to be imported for the purpose of making experiments. These experiments resulted in the recommendation that an important light should be changed from a reflector to a lens apparatus.

It is believed the powerful and unanswerable arguments contained in the letters of Sir David Brewster, in 1833, to the Bell Rock committee, (Northern Lights Commissioners,) in favor of lenses, contributed greatly to the early introduction of them into the lights of Scotland.

Notwithstanding the numerous experiments from 1825 to 1834, made by the Northern Lights Commissioners to test the relative merits of the two systems, it was not until the latter year that decisive steps were taken to decide the question.

In October, 1835, the reflecting apparatus of the revolving light at Inchkeith was removed, and dioptic apparatus substituted.

So great was the satisfaction which this change produced, that another light was immediately changed to a lens light. The second lens light erected in Scotland was at the Isle of May, in September, 1836.

The Trinity House, London, fitted the Start Point light with a lens apparatus in 1837.

The Turkish Government employed an English engineer in 1836-'37, to make experiments with the Fresnel lenses, Drummond's light, &c., to enable it to decide upon the best illuminating apparatus for the Bosporus from the Black sea. The letter upon this subject from William Henry Barlow, Esq., which was read before the Royal Society of London, will be found to contain much valuable information for those interested in the experiments of light-house navigation. (Vide Philosophical Transactions of the Royal Society of London, 1837, p. 211.)

NUMBER OF LENSES IN THE WORLD.

At the present moment, (1851,) there are lens lights of the three first orders (first, second, and third orders) 216, and of the smaller classes 152; making the total number of lenses 368.

They are found now in England, Scotland, Ireland, France, Belgium, the maritime States of Germany, Denmark, Norway, Sweden, Russia,

* Robert Stevenson, Esq.
(the Russian Government has a French artist established at St. Peters-
burg, for the manufacture of lenses for their lights,) Italy, Spain, Por-
tugal, the Mediterranean, Egypt, Turkey, East and West Indies, Brazil,
and, in general, in all the colonial dependencies of the European States.
One first, two second, and one third-order, are the only lenses at present
in the United States.

The three first named were procured in obedience to special acts of
Congress, and the third order was placed on the Brandywine shoal by
the Topographical bureau.

It is understood that the two light-towers now in the course of erec-
tion at Sand Key and Carysfort reef, under the direction of the Topo-
 graphical bureau, are to be fitted with first-order lenses.

Mr. Stevenson pays this merited tribute to the distinguished savan
whose system is now almost universally admired and adopted through-
out the maritime world: "Tresnel, who is already classed with the greatest
of those inventors who extend the boundaries of human knowledge,
will thus at the same time receive a place amongst those benefactors of
the species who have consecrated their genius to the common good of
mankind; and, wherever maritime intercourse prevails, the solid advan-
tages of his labors have procured will be felt and acknowledged."

RELATIVE ECONOMY OF THE UNITED STATES AND FOREIGN LIGHTS.

APPROPRIATIONS FOR LIGHT-HOUSES, &c.

Approved August 10, 1846.

For 2,577 lamps, supplies, &c. $112,883 64
For 236 keepers' salaries 100,588 33
For annual inspections 2,000 00
For commissions to superintendents for purchases, &c. 10,038 77
For annual repairs and alterations 67,077 99

292,588 73

Annual cost of maintenance per lamp, $113 51.
For 30 floating lights 97,711 62
Annual cost of maintenance per light-vessel, $3,257 05.
For buoys and beacons, raising, cleaning, replacing, &c. 31,431 69
For new lights, &c. 24,800 00

Total amount appropriated for lights, buoys, beacons, &c.,
for 1846 446,532 04

Approved March 3, 1847.

For 2,594 lamps, supplies, &c. $113,478 64
For 238 keepers' salaries 101,538 33
For annual inspections 2,000 00
For commissions to superintendents for purchases, &c. 9,812 82
For annual repairs, &c. 65,455 10

292,284 89
Annual cost of maintenance per lamp, $112 68.
For 30 floating lights.......................................................... $85,669 48
Annual cost of maintenance per light-vessel, $2,855 65.
For buoys, beacons, &c., raising, cleaning, replacing, &c. 24,871 43
For new lights, &c.................................................. 516,950 00

Total amount appropriated in 1847 for lights, buoys, beacons, &c................................. 919,275 80

Approved March 27, 1848, and August 12, 1848.
For 2,976 lamps, supplies, &c.................................... $163,840 77
For 273 keepers’ salaries............................................... 114,948 33
For annual inspections............................................. 2,000 00
For commissions to superintendents for purchases, &c................ 12,346 15
For annual repairs, &c........................................... 78,889 67

Total..................................................................... 372,024 92

Annual cost of maintenance per lamp, $125 35.
For 31 floating lights.................................................. 95,915 02
Annual cost of maintenance per light-vessel, $3,094 03.
For buoys, beacons, &c., raising, cleaning, replacing, &c. 35,156 28
For new lights, &c.......................................................... 343,493 90

Total amount appropriated for lights, buoys, beacons, &c., for 1848............................... 846,590 12

Approved March 3, 1849.
For 2,848 lamps, supplies, &c................................... $135,103 60
For keepers’ salaries.................................................. 116,198 33
For annual inspections............................................. 2,000 00
For commissions to superintendents for purchases, &c................ 11,673 25
For annual repairs, &c........................................... 81,714 04

Total..................................................................... 346,689 22

Annual cost of maintenance per lamp, $121 91.
For 33 floating lights.................................................. 102,236 65
Annual cost of maintenance per light-vessel, $3,098 08.
For buoys, beacons, &c., raising, cleaning, replacing, &c. 29,677 46
For new lights, &c.......................................................... 281,598 37

Total amount appropriated for lights, beacons, buoys, &c., for 1849............................... 760,201 70

Approved September 28, 1850.
For 3,110 lamps and supplies, &c................................ $147,474 19
For keepers’ salaries.................................................. 127,448 33
For annual inspections............................................. 2,000 00
For commissions to superintendents for purchases, &c..... $12,253 60
For annual repairs, &c........................................ 84,630 60

373,806 72

Annual cost of maintenance per lamp, $120 19.
For 40 floating lights........................................ 93,140 77
Annual cost of maintenance per light-vessel, $2,328 51.
For buoys, beacons, &c., raising, cleaning, replacing, &c.. 39,449 92
For new lights, &c........................................... 648,320 00

Total amount appropriated for lights, beacons, buoys, &c.,
for 1850.................................................. 1,149,717 41

Approved March 3, 1851.

For 3,993 lamps, supplies, &c................................ $152,081 59
For keepers' salaries........................................ 127,003 33
For annual inspections...................................... 2,000 00
For commissions to superintendents for purchases, &c..... 12,908 92
For annual repairs, &c........................................ 89,698 64

388,692 48

Annual cost of maintenance per lamp, $124 05.
For 40 floating lights........................................ 108,565 24
Annual cost of maintenance per light-vessel, $2,714 13.
For buoys, beacons, &c., raising, cleaning, replacing, &c.. 37,008 02
For new lights, &c........................................... 256,735 00

Total amount appropriated for lights, buoys, beacons, &c.,
for 1851 .................................................. 786,000 74

Recapitulation.

Annual cost per lamp for 1846.............................. $113 51
Do. do. 1847........................................ 112 68
Do. do. 1848........................................ 125 35
Do. do. 1849........................................ 121 91
Do. do. 1850........................................ 120 19
Do. do. 1851........................................ 124 05

For six years.................................................. 717 69

Annual average cost per lamp for the last six years, $119 55.
To this sum should be added the salaries of the numerous custom-
house officers who attend to the duties connected with the lights, and
who receive their salaries from a different appropriation.
The lights of the United States, with the exception of the lens lights
at Navesink, Sankaty Head, and Brandywine shoal, and the reflector
lights at Bayou St. John, Frank's island, Southwest Pass, South Pass,
(Gordon's island,) Pleasanton's island, Cat island, Pass Manchac, Vermillion bay, Cape Florida, Turtle island, Egmont Key, and Execution Rocks, (twelve lights having assistant keepers,) have but one keeper each; while the rock lights (those in isolated positions) have from three to four keepers, and every sea-coast light not less than two keepers each, in all the countries of Europe and their dependencies.

Add the additional expense for an increased number of keepers to render our lights efficient in that department, and the annual cost per lamp will be increased to an amount greater than the reported annual cost per lamp of the European lights.

The Trinity House (English) lights, being chiefly first-class sea-coast lights, (harbor and other local lights, and other aids to navigation, being under the control of the different local corporations,) cost per lamp per annum ................................................. $142.88
Scotch, as above................................................................. 133.50
Irish sea-coast lights....................................................... 102.00
Irish harbor lights........................................................... 118.00
United States, average for six years............................. 119.55

The foregoing statement of the annual cost per lamp for maintaining the lights of Great Britain and Ireland, prior to the introduction, by the light-house boards of that kingdom, of the large number of Fresnel or lens lights now in use, is found from the most reliable sources.

This mode of comparing the lights of other countries with those of the United States is not fair, inasmuch as, by it, the most powerful and best attended lights are placed on a parallel, in a financial point of view, with those in every respect inferior to them.

In this estimate all the lights of the United States are included, from the pier-head, with a single lamp on it, to the largest and most important sea-coast light; on the contrary, the English and Scotch lights are generally sea-coast lights, fitted with a greater number of lamps and reflectors than the lights of relative importance in this country, and the distinction between sea-coast and harbor lights is made in Ireland. (See tables of English, Scotch, and Irish lights, with the different numbers of lamps, and compare them with the table of the United States lights.)

The lights of the United States have not the benefit of the best illuminating apparatus of the kind, in general use; they are not inspected regularly at short intervals of time, and do not receive the same care and attention which is bestowed on the European and the colonial lights; hence the mere estimate of relative annual expense can afford no just idea of their comparative useful and economical effect.

In Europe, the ablest engineers and scientific men are employed on the subjects of construction, illumination, ventilation, and other highly important investigations, connected with a properly organized light-house establishment, who are paid for their services from the funds of the establishment.

In this country, no such system obtains; for, whenever an officer of ability is to be charged with light-house duties, he is detailed from the Army or Navy for that service, and his pay comes from the appropriations of those departments; thus saving to the light-house account large sums annually, which would otherwise be placed against it.
It is also known that, notwithstanding the large amounts annually appropriated for repairs and renovations, yet there are many towers and buildings, and much illuminating apparatus, &c., requiring large outlays for necessary repairs.

The average annual cost of maintenance of the light-vessels of the United States, and the illuminating apparatus employed in them, for the last six years, is $2,891 24. "The illuminating apparatus used in our light-vessels is the compass lamp.\" "No Argand burners and lamps are used." "It is simply a reservoir to hold the oil, with a number of wicks placed around the circumference;\" (solid cord-wicks, the flames being fed only by the exterior current of air.) See letter of Fifth Auditor to Light-house Board.)

"The light-vessels in England are fitted with Argand lamps and burners, and parabolic reflectors, for both fixed and revolving lights." (See Senate Doc. No. 488, page 16, 1st session 29th Congress. See, also, Trinity House returns to Parliament.)

In 1849, seven (nearly one-third) of the Trinity House floating lights were fitted with revolving reflector apparatus.

Of the forty United States light-vessels, on the corrected list furnished to the Light-house Board, twenty-eight are placed in sounds, bays, and rivers, in positions of comparatively little exposure. They vary in size from 54 tons to 180 tons; average 103 tons each.

There are two condemned iron revenue cutters, 400 tons each, in positions which are not much exposed.

The ten remaining light-vessels are in more exposed positions; varying in size from 129 tons to 230 tons, and averaging 171 tons each. The Sandy Hook light-vessel, of 230 tons, is in a position of as great exposure as any on the coast, and is the largest of all the light-vessels proper.

The Sandy Hook light-vessel and the Stratford Point light-vessel cost, for maintenance, in 1850 .......................................................... $11,527 14

The Stratford Point vessel being 100 tons, (under the average size,) it may be assumed that the average will be a fair amount for maintenance ........................................... 2,891 24

Thus leaving for the annual cost for maintenance of the Sandy Hook light-vessel ........................................... 8,635 90

Although this light-vessel is in an exposed position, there are many in the English and Irish channels, and off the coast of Great Britain, in much more dangerous ones, and more difficult to be kept at; still they seldom break adrift. The English light-vessels are larger, and, in every respect, greatly superior to those in the United States. The illuminating apparatus and moorings, (to insure certainty of position,) are of the best quality. Large crews, under the command of able seamen and mates, have charge of these vessels, and few casualties occur. Spare vessels are always ready and kept near at hand; and, in consequence of the superiority of the illuminating apparatus, they are seen nearly as far as shore-lights of the same elevations.

Fog-signals, consisting of gongs, blue-lights, &c., are supplied to these
vessels, as well as all that is necessary for aiding the shipwrecked. The following average for the maintenance of English light-vessels includes all repairs, renewing old ones, &c. In the United States special appropriations are made, whenever new vessels are required to replace old ones; but these do not appear in the average of the annual cost of the United States light-vessels:

The average cost of light-vessels of the Trinity House, for

1844, was, for each one.......................... $6,100 00
1845, was, for each one.......................... 4,850 00
1847, was, for each one.......................... 6,400 00
1848, was, for each one.......................... 7,900 00

No returns for 1849-'50 and '51.

4) 25,250 00

Annual average for four years.......................... 6,312 50

Average for the United States light-vessels—*inferior in every respect to the English*—$2,881 24.

Take the Sandy Hook light-vessel (being the largest and in an exposed position) for comparison, though not larger nor in a more exposed position than nearly all of the English vessels: $8,635 90; giving a difference in favor of the English light-vessels, on the score of annual expense, of $2,323 40

The quantity of oil consumed in the "compass lamp" is very small, compared to that consumed in Argand lamps; and some of the English light-vessels have as many as twenty-four lamps and reflectors; the useful effect being on an average in the proportion of 1 to 4: that is—in illumination alone—the English light-vessels are four times as useful as the United States floating lights.

The average cost per light-house of the American lights and those of Great Britain, for the different years, with the number of lamps and reflectors on an average in each, also exhibits the comparative economy of the lights in the two countries.

1850, United States lights—averaging 9 3/16 lamps each; cost on an average.......................... $1,218 74

1843, Trinity House lights—sea-coast; averaging 13 lamps each.......................... 1,840 50
1844, Scotch lights—sea-coast; averaging 17 1/3 lamps each.......................... 2,322 00
1844, Irish lights—averaging 20 lamps each.......................... 2,043 00
1844, Irish harbor lights—averaging 7 1/3 lamps each.......................... 877 50
English colonial lights—averaging about.......................... 1,150 00

The American lights have but one keeper, except, in about a dozen instances, a single assistant is allowed. In the English, Scotch, and Irish lights, all sea-coast lights have not less than two keepers, and many of them, from their very exposed positions, have three and four keepers each.

No comparison can be made of the French and American lights, from
the fact that there is not a single first-class light on the American coast, and there are no reflector lights of any note remaining in France.

A reference to the returns of expenses for maintenance of British colonial lights and light-vessels will show favorably in comparison with ours.

The average annual cost of keeping up the Irish floating lights was, in 1846........................................ $2,700 00
The annual average cost of keeping up the Irish floating lights in 1848, about ........................................ 2,500 00
Or an average of about........................................ 2,600 00

The Irish light-vessels are generally smaller, and placed in less exposed positions, than those of the Trinity House; though in some instances they are in equally, if not more, exposed positions than those of England, and in much more exposed positions than the majority of those in this country.

There is but one floating light in France, fitted with the best dioptric apparatus, but kept up at a very small expense per annum.

The Scotch have no floating lights.

The average of the annual appropriations for buoys, beacons, lights, &c., in this country, is.......................... $813,668 60
For purchasing supplies, delivering them, and making one visit of inspection annually, in 1851......................... 152,081 59

Transportation of supplies .................................... $11,487 00
Inspections once a year.......................................... 3,200 00
Commissions on purchases...................................... 12,908 92

27,545 92

For this sum the most rigid system of inspection, superintendence, instruction and accountability might be introduced, and a more expeditious mode of delivering supplies at short and stated periods introduced; and hence a strict accountability on the part of those employed in the service. The repairs of the illuminating apparatus, involving an annual expense of $12,188, would then be made by mechanics of known skill, under the supervision of a competent engineer.

The large sums expended annually for repairs, show clearly that the buildings were either badly constructed at first, or that the repairs are not made by competent persons, and under the inspection of competent engineers. The towers and dwellings of the lights visited, attest the truth of the great want of true economy in this branch of the light-house establishment. Light-keepers’ supplies are not accounted for as rigidly as a proper system would require. The returns of the expenditures of oil, wicks, chimneys, &c., are too partial, or in too general terms, to admit of proper scrutiny. No rule or system is followed in delivering supplies to light-keepers. The person charged with that duty delivers such articles, and in such quantities, as he thinks proper, and requires
the keepers to receipt to him for them. The quality of the articles is frequently inferior to the requirements of the service, especially in the articles of polishing powders, trimming scissors, glass chimneys, wicks, &c., and, in many instances, of oil.

There are no inducements held out to keepers to use proper economy in the management of their lights, and no checks upon them.

In procuring light-house supplies of all kinds, too little regard seems to be had as to quality of the articles, and too much latitude given to those who may be interested in the purchases. Articles are procured and left with the keepers, which are of inferior quality; extra lamps and burners, reflectors, &c., are often left at light-houses where no good reason could be discovered for having so large a number of spare articles at one point. At Reedy Island light-house, (a gas-light,) a complete set of new lamps and reflectors was found, in addition to a set of lamps and reflectors kept ready to be put up, in the event of having difficulty with the gas-light.

There is no regular list of articles required for the different light-houses; no indications to guide the keepers, by which they are to judge of the quality of the supplies.

Delays, consequent upon the mode of delivering supplies only once a year, in making repairs, have proved detrimental to the public service.

The absence of a proper inspection and superintendence of the repairs of towers and buildings, has been apparent in nearly every instance which has come under the observation of the board. The mode by which contractors for repairs, and for new structures, obtain certificates of having performed faithfully the work contracted for, is reprehensible, and should not be permitted in future. There can be no true economy where the contractors are not held to a strict accountability, and the work intrusted to them not executed under the immediate supervision of a responsible and competent engineer. The present defective mode of construction and repairs of towers and dwellings may be remedied by carrying out the ninth section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851:

"Sec. 9. And be it further enacted, That the President be, and he is hereby, required to cause to be detailed from the engineer corps of the Army, from time to time, such officers as may be necessary to superintend the construction and renovating of light-houses."

RELATIVE ECONOMY OF UNITED STATES AND FOREIGN LIGHTS—CONTINUED.

The fifteen lamps and twenty-one-inch reflectors placed in the Cape Cod light-house in 1840, cost each complete.............$111 90
The eighteen lamps and twenty-one-inch reflectors placed in the Cape Henlopen light-house in 1840, cost each, as estimated with other repairs made by the same contractor............... 88 90
The fourteen lamps and twenty-one-inch reflectors, made in London and placed in the Boston light-house, cost each...... 131 50

In the case of the Cape Henlopen light, other work was executed by the contractor who furnished the lamps and reflectors, amounting to $2,000 additional, while the contractors for the lamps and reflectors for
the Cape Cod and Boston lights only furnished the lamps and reflectors, precluding the possibility of placing the lamps and reflectors furnished by them at any other than a fair compensation for their materials and labor. The contractor, on the contrary, had a large margin for making up his deficiencies in that branch of the work, at Cape Henlopen.

Taking, then, these three lights, the comparison of relative merits and cost will appear as follows:

The Boston reflectors and lamps, made in the best manner, form, shape, and finish, cost........................................ $131 50
Six ounces silver to the pound of copper used in their construc-
tion, making, in actual silver, between $50 and $60 each—
say.......................................................... 55 00

Leaving for other materials and labor...................... 76 50

The Cape Cod reflectors and lamps, made in Boston, cost each $111 90
Fifteen ounces silver to each reflector....................... 15 00

Leaving for other materials and labor...................... 96 90

The eighteen lamps and twenty-one-inch reflectors put up at the Cape Henlopen light, by a different contractor from the one employed to make the Cape Cod lamps and reflectors, cost each, on the general estimate for the repairs........ $88 90
Fifteen ounces silver-plating................................ 15 00

Leaving for labor and other materials....................... 73 90

The present condition of the reflectors now in Boston light, made in London, and put up in 1839, compared to those put up in the Cape Henlopen light in 1840, is sufficient evidence of the fact that the Boston reflectors, although costing the most, are, in true economy, the cheapest. In the Henlopen light the silver is worn off the reflectors in many places, while the Boston light reflectors are still good.

Deducting the difference in silver actually used for the plating, and the cost of the Boston reflectors is only $2 60 more than those put up at Cape Henlopen about the same time, and now nearly worn out. The difference, compared with the Cape Cod reflectors, is in favor of the Boston light, (assuming that the quantity of silver for plating is correct, that being the quantity contracted for by the general superintendent of lights, &c., for all reflectors of that size.) As this light was not visited by the board, the condition of the reflectors is not known.

The following are the prices paid for reflectors of twenty-one and a half inches, fitted with brass vase lamps, complete:

At Birmingham, England, Soho Company.

For 21½-inch reflectors and lamps, with six ounces of pure sil-
ver to the pound of copper........................................ $142 00
For the same, with four ounces of pure silver to the pound of copper ................................................................. $113 25
For the same, with two and a half ounces of pure silver to the pound of copper ...................................................... 93 25

In London.

For strong, silver-plated, highly-polished parabolic reflectors, twenty-one inches diameter, with improved patent lamp..... 122 00
The same, with inferior plating.................................................. 109 00

The present contract price for twenty-one-inch reflectors, having fifteen ounces only of silver on each of them, without lamp, burners, or fixtures, is, in this country, sixty dollars. In addition to this, the same contractor supplies various articles, by which he may easily reimburse himself, should there be any loss on the few reflectors annually required for the lights, compared to the amount paid for stores; besides, the quality, shape, and finish of those most recently made, seen by the board, are greatly inferior to what they should have been.

Parabolic reflectors, well made, with such a thickness of silver plate as is required, and only employed in the few remaining reflector lights of Scotland, if properly cared for, and no improper cleaning materials are used, will last, probably, upwards of twenty years, while those of an inferior quality require to be renewed in from ten to twelve years, if good lights are kept.

That these articles can be as well made in this as in any other country, no one can doubt; but it is necessary that our skilful mechanics should have a fair remuneration for their materials and labor, to insure the best articles. If an unprofitable contract is made by the Government with an individual, it is neither just nor reasonable to suppose that the Government is to gain at the expense of the mechanic's labor. By the introduction of a wholesome system of inspection and superintendence in these important matters, it would soon be ascertained for what amount the different qualities of apparatus could be manufactured, rendering justice to all parties. The Government would then be certain of having the best articles; and the manufacturer, of a fair remuneration for his labor and materials. There is no true economy in a system of extravagant annual repairs, and a constant renewal of apparatus.

The fabrication of parabolic reflectors for light-houses requires ability, care, and great labor. The form is a most essential element; the finest polish, &c., another; and the quality of the plate equally important. Reflectors, such as have been seen by the board, might be made at almost any price, above the actual cost of the materials used. A pretty fair estimate of the quantity of silver employed on reflectors of 21 inches diameter may be formed.

They weigh usually from nine to eleven pounds when finished, of which quantity, of the best construction, every pound of copper gives six ounces of silver; and so on, to the most inferior quality. It has been seen elsewhere in this report, that the Trinity lights cost per annum ................................................................. $142 88
The Scotch ................................................................. 133 50
The Irish sea-coast......................................................... $102 00
The United States, average for six years....................... 119 55

It must be remembered, also, that as a general rule (and there are only about 14 exceptions) there is but one keeper to the lights in the United States, while no sea-coast or important light in England, Scotland, or Ireland, is not furnished with at least two keepers, who receive on an average, including fuel, rations, &c., larger salaries than the keepers in this country.

In Great Britain, inch burners, and in this country \( \frac{2}{3} \)-inch burners, are used, making considerable difference in expense of oil, as well as in the power of the light.

The colonial lights of Great Britain, with two or more keepers, cost much less per lamp and per light-house, per annum, than those of Great Britain or the United States.

The large repairs, and frequent renewal of the apparatus in the United States would alone suffice to render the establishment one of less real economy than those of France, England, Scotland, and Ireland.

These lights abroad have no custom-house or other officers to superintend them free of charge, as in this country.

It has been found in Great Britain, that the expense of fitting up a revolving light with 24 reflectors, is.............. $5,763 13
And the fitting up one with lenses, with all the accessory parts and improvements, is........................................ 6,477 96

By calculating the difference in cost of annual maintenance, and allowing for interest on the first cost of the two systems, it will be seen that there will be an annual saving of $283 72 by the lens apparatus, and at the same time a better light; an apparatus, too, that will never require to be renewed.

The first cost of the smaller lights in the two systems may be put down as follows, assuming that the lanterns and everything relating to the buildings will be equal in both systems:

First-cost of a fixed sixth order lens with 3 lamps complete.. $216 00
First cost of small harbor or beacon light, for lamps and reflectors only, (see present contract, appendix) ............... 297 50
First cost of a fifth-order lens with 3 lamps complete........ 354 00
First cost of a reflector light equivalent to it, from $297 50 to $387—mean. ....................................................... 342 25
First cost of a fourth-order lens with 3 lamps complete, with chandelier and accessory pieces....................... 661 00
First cost of a fixed reflector light, as nearly equal to the fourth-order lens as possible, is not less than $459 to $567—mean............................................................. 513 00
First cost of a third-order lens light with 3 lamps......... 1,860 00
First cost of reflectors and lamps to make a light as nearly equal to it as possible—for example, Cape Henlopen, the actual cost of which we have already seen—and after 11 years’ service requires to be renewed, while the lens will last forever....................................................... 1,600 00
For the relative annual expense of maintenance of the lights, and for the comparative brilliancy and useful effect of the Brandywine shoal, a third-order lens light, and that of Cape Henlopen, see remarks in another part of this report, and also the notes of inspection in Appendix A.

For fitting up Boston light-house with 14 twenty-one-inch reflectors........................................... $4,749 16
For fitting up Cape Cod light-house with 15 twenty-one-inch reflectors........................................... 5,919 40
For fitting up Thatcher's Island light-house, 2 lights, 20 twenty-one-inch reflectors........................................... 5,360 00
For Cape Henlopen, new lantern, and 18 twenty-one-inch reflectors........................................... 3,500 00
For Cape Henry, as above........................................... 4,000 00

Compare these sums with the cost, as estimated above, for a revolving light with 24 large parabolic reflectors, costing nearly double the estimated cost of those used in this country, and it will be seen that the difference will be in favor of the foreign light; that is, increase the number of reflectors in the Boston light to 24, and instead of $4,749 16, add the cost of the ten additional ones, and the whole cost will be $6,064 16. In the cases of Cape Cod and Thatcher's island, the difference will be much greater in favor of the foreign economy.

There are at present forty-two floating lights authorized by law, and two more (one for the South shoal off Nantucket, and another off Cape Fear, Frying-pan shoals) are required. To render these forty-four light-vessels useful and economical, it is indispensable that they should be fitted with Argand lamps and parabolic reflectors, requiring about five hundred and forty in all. To accomplish that purpose without much expense to the country, it will only be necessary to take from the thirty-eight sea-coast lights proposed to be converted into first-order lens lights, with as little delay as possible, all their reflectors and lamps, and placing the best of them in the most important light-boats, which will produce a net saving of many thousands of dollars; while the country is only doing what it is bound to do, in saving human life and property from destruction.

These thirty-eight reflector lights contain about 540 lamps and reflectors, the number required to fit up all the light-boats.

They would cost, if purchased, from $35,000 to $45,000, and would be equivalent to that sum gained in the purchase of the necessary lenses for the sea-coast lights.

The absolute necessity for fitting up the light-vessels with proper apparatus has already been clearly shown. The necessity for better sea-coast lights has also been seen. The great saving in expense by the introduction of the lens system is clearly demonstrated, both by theory and practice. It is important to remember, that in many of the light-houses the introduction of the lens apparatus will be attended with no other expense than the actual cost of the lens and that of putting it on its pedestal. All the lanterns fitted with plate glass, and in tolerably good condition, will answer as well for the lens as the reflector apparatus, and
in many instances better. The reflectors, as a general rule, take up much more room than the lens apparatus. If repairs are required at all, they will be required with either kind of illuminating apparatus.

The great defect to be remedied is one that exists independently of both systems: that of want of sufficient elevation. (Vide appendix, showing heights of the principal sea-coast lights in this and foreign countries.) Time, and a gradually progressive improvement in this important branch of public service, must remedy this glaring defect. The introduction of other apparatus will not mitigate against such gradual improvements. From the perfect character of the lens, it can be taken down and put up without fear of injuring its efficiency.

DESCRIPTIVE LIST OF LIGHT-HOUSES, BEACONS, BUOYS, AND SEA-MARKS.

The board have endeavored to obtain from the general superintendent of lights, &c., the data for such a descriptive list; but the materials are not probably in the office for its composition. The list transmitted to them of beacons and buoys, was obviously too imperfect to answer the purposes intended by the Department. They have, therefore, taken steps to procure from the local superintendents the necessary information, with which they have commenced compiling such a list as the instructions prescribe, of all the light-houses, beacons, buoys, &c., which, when completed, will be presented in a future report to the Department.

The list of light-houses and light vessels, printed by authority of the general superintendent of lights, &c., in 1851, is deficient in many essential points of descriptive detail, is not sufficiently widely circulated among seamen and others interested in commerce and navigation, and is in some instances incorrect. The president of the board called the attention of the general superintendent to this latter point.

The lights along the coast should be placed on the list in the order of their positions on the coast, commencing at one boundary or the other, having regard especially to their latitudes and longitudes.

The names of the sea-coast and other first-class lights should be printed in capital letters, as a signification of their character.

The names of the first-class lights should correspond, as nearly as possible, with the most prominent point of coast near which it is placed. Names of small islands, inlets, &c., which are scarcely known beyond their neighborhood, should never be used to designate a sea-coast light. Numerous instances of this kind might be pointed out as existing on the present light-house list.

In compiling a proper descriptive list of the lights, especially with reference to those of the first class, and most important to the over-sea voyager, the chart of the coast should be the guide; commencing, for example, at our northeastern boundary, take the entire coast line to the Rio Grande.

The secondary (bay, harbor, and river) lights might be placed in the order in which they are placed in ascending from sea. Take as an example the Delaware bay, &c. Coming from the east, "Cape May revolving light," &c., would appear in capitals; next to it would be placed "Cape Henlopen fixed light" in capitals. Then should follow, in smaller
type, all the light-houses and light-boats, in their regular order, alternating from side to side of the bay, as far as they reach. The same rule should be observed with all other bays, harbors, &c.

Montauk, Fire Island inlet, and Highlands of Navesink should appear in the same order, and printed in capitals; then should follow Sandy Hook, East Beacon, West Beacon, &c., in smaller type; but each light, whether large or small, should be minutely described, so that the stranger can never be at a loss to know where he is, on first seeing the artificial means provided by the Government for that purpose. Lights supplied with fog-signals should be stated in the remarks. Views of the coast, embracing all the natural and artificial objects calculated to aid the navigator, are placed on all the coast survey charts; but these aids are omitted on those now generally in use by navigators. It therefore becomes the duty of the officer charged with the management of the lights, &c., to see that no item of description should be omitted in the lists of lights, buoys, beacons, &c.

Correct and carefully made descriptive lists of beacons, buoys, and sea-marks, embracing bearings, objects intended to be subserved, &c., of every bay, river, and harbor, should have a place in the general light-house list, to which notes, explanatory remarks, &c., should be added, relating to removal, replacing, &c.

The Department has further required of the board, in accordance with the phraseology of the law, a

Detailed Programme to Guide Legislation in Extending and Improving the Present Mode of Construction.

On this subject, the board submit from their committee, composed of the two engineer officers serving as members, the following report:

The number of light-houses has increased under our present form of government from about eight sea-coast lights, given to us by the war of the Revolution, to 315 of all classes, according to the official reports for the year 1851; but these do not include all that have been built by the United States. In the year 1791 were built the first light-house towers. Thenceforth the number of these establishments continued to increase, until at the close of 1819 there were 64 within our limits; so that in the course of twenty-nine years there were 56 erected. In the succeeding twenty-three years, or from 1820 to 1842, (inclusive,) there were erected some 200, and from 1842 to 1850, (eight years,) 57 more, or in all 315. But from these numbers we are not to infer that, up to the period stated, there were no more constructed, for, on the contrary, a number of those on the official lists have been rebuilt or refitted, at considerable cost, (we refer especially to the official report for 1842 and the official list for 1848.) It is worthy of notice that this source of expense is not found to be uniformly distributed, either geographically or with reference to the age of the buildings. We find that the greater number of reconstructions have been confined to a very few States, remote from each other in geographical position, and that they have been found necessary in the case of new as well as of old structures. For example: thirteen light-houses had been rebuilt in Massachusetts alone, to the
year 1848, and in the State of Maine eight. In some of the States it has not been found necessary to rebuild any, even those of considerable age, whilst in Florida, where all that have been replaced were comparatively new, there have been seven out of fifteen rebuilt, at a cost of nearly $74,000. These numbers (namely, the number of those rebuilt) are strikingly great in proportion to the whole of the list of existing works; and they are still more worthy of attention, if we add to them the number that have been refitted wholly or partially, or about seventy. Again, it should be remembered that four-fifths of the light-houses we are referring to have been erected since the year 1819—namely, those reported to the 1st of July, 1842; for that report, as already said, gives 264 as the total number of light-houses, 200 of them having been built or rebuilt since 1819, or during the twenty-three years immediately preceding, and only sixty-four of them being over twenty-three years old. We have not the precise elements for calculating the percentage on the first cost of construction, but the materials at command would indicate as probable four or five per cent. as the annual charge for repairs.

Very generally these structures are anything but creditable to the reputation of those who have had the charge of erecting them. So far as our own observation extends, and in many other cases, according to very credible testimony, they are inferior, as well in the materials as in the workmanship; often, very remarkably so. The same judgment has also been given by others heretofore, and it has not been controverted. But we conceive that the official reports and statements furnish of themselves very strong evidence of its soundness; we would therefore call particular attention to those estimates, and especially to the very large sums annually asked for under the caption of "repairs, &c., of light-houses." We are not instructed as to the items intended by the very general clause we find in this heading, but we may reasonably presume that it has reference only to such expenditures as connect themselves with the renovation or preservation of these structures, because any other assumption would be adverse to the idea of an intelligent classification of the items of expenditure. The official estimate for the fiscal year 1850-'51 (the last) for repairs, &c., of light-houses, is nearly $86,000, at the rate of probably four or five per cent. per annum on the original outlay, in order to maintain them even in the state of dilapidation in which several of them are now to be found. We give the aggregate cost of repairs for that year on all the light-houses, old and new, well and badly built, and the comparatively new comprehend a very large portion of the whole. If we were to pursue the investigation in this report as far as we have in the documents, it would be seen how small the general average of four or five per cent. per annum would be, compared with particular cases, and how very costly, in fact, are the works of inferior construction. But to the expenditure for repairs should be added that for the reconstruction of such as have been decayed, or destroyed, otherwise than by an enemy. This addition would very seriously increase the sum now included under the head of repairs; and it might further be enhanced by adding the expenditure for refitting, more or less extensively, some seventy light-houses.

We may infer from what has been said, that it is not always economi-
cal to build low-priced light houses; for if even they were to require an expenditure of only four per cent. per annum on the original cost of construction, in order to maintain them in a doubtful state of repair we would have expended upon them as much money as would, at the end of twenty-five years, enable us to erect structures of great strength and durability in their stead, or such as would be beyond the hazard of the elements. Nor is this statement based upon extreme or on a few cases. We have, it is true, light-houses which have stood more than twenty-five years, and still require but little repair. These, however, are the exceptions to the rule. We have the case of many others that have stood more than one-fifth of that time, and some that have not stood even so long as that. But the economical difference in favor of a well and substantially-built light-house is this, namely, that with the one there is an unlimited security with respect to time, and without further cost than the original outlay, whilst with the other there is an ever-increasing expense, and an ever-increasing insecurity.

With the exception of works designed to resist the fire of heavy batteries, there are, perhaps, among the higher class of structures, none that require so careful a selection of materials, nor greater professional knowledge, care, and skill in their preparation and combination, than is required in the building of works exposed to the shock of the sea, or even in those which, near the ocean, receive only the slow attacks of time and of the weather; and most especially is this true of light-houses built in such situations. Their small bases, great height, and naked exposure, subject them, in an eminent degree, to the influence of the causes which operate everywhere to the destruction of artificial works, and especially where they are exposed to the waves, to the spray, or even to the sea atmosphere.

Nevertheless, it has been, in general, the practice of this Government to abandon these works to the chance management of whomsoever might undertake them for the lowest sum; and to them are intrusted, very generally, the construction of our light-houses, and in the absence, too, of any efficient system of inspection. And this is not the fault of today only; it has been the practice ever since the enactment of the organic law of the light-house establishment in 1789. Under such a system, we cannot be surprised to find these structures badly built, and costing such large sums for the repairing, refitting, and rebuilding of them. Our light-house establishment seems to be the sole exception to our practice of building for the future as well as for the present. In it there seems to be ever a lurking apprehension that our naval and commercial existence is but temporary. But it seems to us that the nation owes so much of its prosperity and power, and so much of the renown it has acquired, to our marine, military and commercial, that its safety, whilst afloat, should be carefully provided for, and with a liberal hand. Very large sums of money are yearly expended by the Government in erecting not only solid but richly-decorated structures for the storage of the cargoes of our merchant ships, and for the collection of the revenues arising from them; similar examples of liberality manifest the disposition of the Government with respect to all the other great
works it has undertaken, and especially we may exemplify this liberality in the case of the public buildings at the seat of government; in the fortresses of the country; in its arsenals, and in its great naval establishments; all of which are of the first character for the excellence of their workmanship and materials, and for the ability with which they have been designed, and the fidelity of their execution. So that we may reasonably hope that liberality may be extended hereafter to the light-house system, upon the perfection of which so much depends the security of our navigating interests; and the more so, since the nation has attained to a character for permanency which may well warrant the expenditure of money for the purposes of the future, and because, in so doing, we will be countenanced by the practice of the wisest and most successful of the maritime powers of the world.

It is evident from what has been already said, that we suppose that light-houses ought to be made as durable as the circumstances of each case will permit, and as secure from casualties; and hence, that the introduction of materials easy of ignition ought to be carefully avoided, as well as those that are liable to rapid decay; and that, therefore, carpentry should generally be excluded from the interior and exterior of such works, if they are of any degree of importance, or intended to be permanent. The same objections apply to the use of wood-work of nearly all kinds (joiner's work) for which there might be substituted in many cases some one or other of the metals. These opinions are founded on the conviction that the introduction of this material to any serious extent into the body of a light-house is very objectionable because of its known liability to decay, especially in a humid atmosphere. But the danger of conflagration is the main objection to the extensive use of timber in the construction of light-houses, because even the utmost care cannot always guard against its occurrence. But there are seasons in which the sudden destruction of one of these establishments might lead to shipwreck. In employing extensively, therefore, any inflammable material in them, we would be but sporting with life and property. These remarks are predicated upon the supposition that the works they refer to are in exposed situations, and that they are, at all times, really necessary to the safety of navigation.

Iron has been employed for some years past as a material for light-houses. It is used both as castings and wrought. There are peculiar situations in which it is preferable to any other. Among the forms in which it has attracted most attention in the United States, is that which connects itself with screw foundations. Those situations most favorable for the employment of these sort of structures are those which are exposed to the action of the waves, where a sandy or even gravelly bottom might be liable to be disturbed by the currents which solid structures under water are so apt to generate, and where any such disturbance might lead to the destruction or injury of neighboring navigable channels. In these cases the impediment presented by a few slender iron piles would be so slight, that they could have no injurious influence upon any of the currents in the vicinity. There are also other localities where the erection of a more solid structure might involve the expenditure of sums of money greatly beyond the value of the structure to
commerce, as there may be also others where the solid surface to be built upon may not be adapted to receive any other kind of structure than that composed of iron piles.

These iron light-houses have not as yet received all the improvements of which they are manifestly susceptible; nor have they, in the public mind, received all the sanctions of experience with reference to their sufficiency or safety. On the contrary, some serious mischances have characterized their history, and have not a little tended to prejudice the public against them, and especially the minds of those who are without the means of investigating the cases of failure which have occurred.

It has been made the duty of our committee to investigate the mechanical principles involved in this sort of structures; the sufficiency of the materials of which they are composed, and their adaptation to the purposes for which designed; and in the performance of this duty, it has had occasion to investigate the causes of the very few failures which have occurred, both here and in Europe. It is very reasonable to anticipate that in the first cases of the employment of so novel a system of building as is this of the iron-pile light-house, precautions may be omitted, and that errors may occur; in planning or executing them, which a more extended experience may correct. We are not, therefore, disposed in such a case hastily to attribute or to censure faults, if any should be committed, in the first experiments. We prefer to profit by the experience of those whose enterprising intelligence and whose opportunities have enabled them to instruct us in regard to them. Since the introduction of the iron-pile light-house into the United States, the system has very largely occupied the attention of the Bureau of Topographical Engineers, and several of them have been planned and executed under its direction. In almost all of them, and especially in those more recently designed, we find most striking improvements upon the models which have come to us from England, where they were first employed; improvements which affect materially their strength, stiffness, and safety, as well as their capacity for the accommodation of those who are employed to take care of them. It has been made also the duty of your committee to plan a work of a similar character for the entrance of the Patapsco river; and into this we have introduced still further improvements, which seem to be of essential advantage in such structures, and which serve to obviate some objections which applied to other similar works.

Other forms of iron light-houses have been proposed, and some have been executed of cast iron. These are designed, generally, for situations out of the reach of the waves, and for situations so remote from more suitable materials of a durable character, that the cost of transportation added to unusually high prices of labor and workmanship, occur as serious objections to the employment of such materials. Some parts of the coast of California may be instanced as suitable for this latter kind of structures.

There are several objections urged against the use of iron as a principal material for light-house towers; one of which, and an important one, is the liability to oxidize, and especially such portions of it as may be much exposed to unfavorable atmospheric and hygrometrical influ-
ences. It is objected, also, that in salt water, cast iron may ultimately be converted into a substance resembling plumbago, and its strength materially injured. The best structures of masonry, if they have a solid foundation, form nearly unyielding masses, scarcely feeling the shock of the waves or the winds. An iron light-house, on the contrary, owing to the great number and comparative looseness of its parts, always vibrates under the influence of these forces. There is, therefore, much friction in it, and this tends necessarily to wear it at all the joints, so that however strong or stiff it may be at first, it must ultimately yield, more or less, to such influences. Moreover, iron castings are liable to flaws, which are not easily detected before they are brought into use. These objections, although not fatal, are undoubtedly deserving of, and have received, consideration. Means have been proposed by which the process of oxidation may be delayed. The quantity of metal in works of equal general dimensions has been recommended to be increased to a degree varying with the exposure of the structure, and, by our committee, effective means have been devised for renewing or repairing at all times, any part, whatever, of the structure that may be found to require it, and this without materially disturbing the structure.

Moreover, under the instructions of the Topographical Bureau, the officers and agents employed upon such works have effected very important improvements in the arrangements requisite for increasing at any moment the stiffness of iron-pile towers, and it has given to them greatly increased accommodations beyond those that had been used by the English engineers, to whom we are indebted for the general principles upon which such works are based. With these improvements and precautions, combined with a prudent increase in the dimensions of the details, varying with the peculiarities of each case, and the security of an ample base for them, we have no hesitation in recommending their use at all the points at which the peculiarities of the locality may render it imprudent to erect works having solid foundations, or where the difference of the cost of these and the usual light-house towers may be such as to be of sufficient pecuniary account. We may mention, as a further important advantage of these iron structures, that they may be, as they always have been, in the United States, put up at the foundry or shops at which they are made, and fully inspected and perfected before they are accepted, and before leaving the yard of the establishment, so that they may be transported to any point, however remote, under the conviction that on their arrival at their ultimate destination, they will, in all their principal details, conform to the plans of those who design them, and will require at such point little more than the expenditure of the sums necessary for their bare erection.

Iron, (cast, wrought, or rolled,) plain, corrugated, or ornamental, may also be often very usefully and economically employed in light-houses, for stairs, galleries, railings, doors, shutters, door and window frames, and for joists, flooring, partitions, &c.

But the materials most extensively used in light-house towers of the best construction, or those from which we are to expect the greatest strength and durability, are brick and stone. In certain situations, and
under certain circumstances, bricks may be very advantageously employed as a material for light-houses, especially where the difference of cost of brick and of stone, of a suitable quality and form, is of importance, sufficient to warrant its preference, and the quality of the material itself is such as to satisfy us of its strength and durability. Under favorable circumstances, and where an unusual power of resistance is not requisite for the stability of the work, the use of brick may be recommended even extensively; and in so doing, we have the experience of some of the most ancient structures extant, which still remain to attest the durability of brick, when employed in situations favorable to it. The most durable specimens of brick-work known to us are those of burnt bricks which have descended to us from the Romans. With us, the clay of which the bricks are usually made, consists of silica and alumina, in combination, sometimes, with magnesia, oxide of iron, sulphate of lime, carbonate of lime, and some other ingredients. On the nature of the constituents, the due mixture of these with water; on the perfect tempering of the resulting paste, and on the time, care, and skill bestowed upon the drying and the burning, or baking of them, depend their strength and durability. Their color, being derived from the minerals which enter into combination with the silica and alumina, of course may be modified by varying the proportions of the coloring-matter, but not always without affecting their quality. The strongest bricks employed in building on the Atlantic coast of the United States, are of a reddish or reddish-gray color, derived from the oxide of iron which abounds in the soils. Bricks of various other colors and shades are also manufactured in the United States. Our reddish-colored bricks are, however, generally the strongest and most durable, as are those of the same color which have been preserved in the works of Rome. The best quality of bricks may be therefore safely employed in works not requiring great strength.

Bricks are, however, sometimes subject to the phenomenon which the workmen call “salt petering;” and they are therefore, however sound apparently, not to be employed without due precautions, especially in the vicinity of the sea, or in connection with mortars, cements, or plasters, into the composition of which crystallizable salts may have entered. But this subject (the salt petering of masonry) will be more fully noticed hereafter.

Whatever the situation in which we may advantageously employ bricks in constructing light-house towers, we might also use stone, and with yet more advantage in point of strength and solidity, and equally as to durability; the stone being of the proper quality, and of suitable form and dimensions. But there are other situations requiring the erection of solid structures, where stone should be used in the exposed parts, to the exclusion of all other materials; especially in positions exposed to the shock of the sea. These remarks, however, are not intended to exclude the use of the requisite cements, or of concretes or beton.

The quality, form, size, and dimensions of the stone to be used in the work are of the first importance, as affecting its strength and durability; and moreover, there are situations where stone of a certain quality might be used as suitable, whilst in other situations the same stone might be
found to be objectionable or inadmissible. Some of the lighter kinds of stone, for example, if they are capable of resisting the disintegrating influence of the atmosphere, or of frost, might be used wherever the use of bricks were justifiable. Situations greatly exposed, as, for example, to the force of the sea, require, on the contrary, stone of great specific gravity, close-grained, and hard, and of large dimensions, not liable to splinter, and free from iron or its oxides, or any other matter liable to oxidize, or to disintegrate, when exposed to the influence of the air, the water, or of frost. But, especially, all the stone used in the erection of the more exposed towers ought to be of large dimensions, in order to band well into the work, to be hammered to beds and points, at least; to be laid in horizontal courses, except in the arches, and everywhere to break joint.

The good qualities of building stone are: a fine and uniform grain, a compact texture, the ability to resist humidity and frost, and the action of fire, and the not being liable to splinter readily. Weight, also, and the ability to resist fracture or abrasion, are among the characteristics of a good building stone. All these conditions being fulfilled, the preference is to be given to those stones that may be most easily and perfectly dressed to form, and most capable of retaining it.

In some situations, the inability of certain kinds of stone to resist the chemical action of salt water, or the attack of certain marine insects, may render them unsuitable materials for the masonry. The same may be said of any stone that adhere to mortar or to the cements. The presence, too, of iron, and of its ores, and, under certain conditions, usual portions of schorl, and felspar, and mica, may be such as require a more than usually critical inspection of the quarries from which they may be derived, and of the stones themselves, preliminary to their introduction into the work, and especially into the exterior.

To ascertain the existence of these qualities in stone to be furnished from untried quarries, time and circumspection are requisite, and an experienced acquaintance with the material proposed for investigation. In the case of a new quarry, the material it is capable of furnishing should be examined, at various points, and even at different seasons of the year, and various specimens should be subjected for a sufficient length of time to the influence of the air, of water, of frost, and with reference to some kinds of structures, even of fire, as well as to the test of the workman's tools, and to those which are ordinarily applied for determining the strength and the specific gravity of materials. In the case of stone to be taken from quarries already in use, the inspection need be but comparatively superficial and extemporaneous; but that inspection should be applied to all the specimens intended to be introduced into the building, so as to assure the rejection of all that are insufficient, unsuitable, or defective.

The particular kind of rock from which the stone must be obtained cannot be predetermined. It must, in a measure, depend upon the facilities of communicating with the quarries, and the cost at which stone of various, though suitable, qualities can be procured. It should conform, as nearly as possible, to the description to be found in the preceding paragraphs.
Whatever may be the description of masonry, in a structure of any magnitude, the stone employed in it ought to have sufficient beds, or bearings; for which reason they should be broad and long, in certain general proportions to their height. They should be dressed so as to obtain as regular and perfect bases as the character of the masonry requires. The larger stones of the courses should band well into the walls, in rubble as in ashlar work, and, as much as practicable, they should break joint with the stone of the courses immediately above and below them.

The stones should be well levelled and settled into their beds, and in such a manner that the natural bed of the stone will be placed horizontally; the use of spaws, wedges, &c., as underpinning, should be disallowed, as leading to the splintering of the materials, and to the settlement of the walls.

Grouting should not be permitted; but the stone should be laid in a full bed of lime mortar, wherever the use of lime is admissible; otherwise, in a mortar made of lime mixed with cement, or of cement alone.

The mortar, of whatever kind, should be employed for the purpose of uniting the material; and if vacant spaces occur among the larger stone, spaws, and other smaller materials, should be freely distributed through the mortar, so as to consume as little as may be of this. The joints should not be large. In rubble-work there can be but little danger of their being too small. In coursed masonry the courses should be well levelled, after the stones composing it shall have been settled into their places.

It would be out of place here to speak in any but very general terms on the subject of the foundations of this kind of works, especially of those of the more important classes of them. Upon the resistance presented by the foundations must necessarily depend the stability of the structure, the slightest yielding of the one being inevitably transmitted to the other. The measures requisite for the security of the foundations are very various, and their application depends upon special peculiarities of each case. But the vertical direction of the force exerted by the weight of the structure is common to all, so that in all cases the resistance should be also vertical, but opposite; and for this reason all the surfaces of the material, not in vertical planes, should be horizontal, except on the exterior and interior surfaces of the building, where they must conform to its architectural outline, and except also in the turning of arches. In order to obtain an equal pressure over the whole surface of the foundation, the specific gravity and the strength of the material of each course ought to be the same for the backing, if any there be, as well as for the face of the work. But it consists better with the solidity and stability of the work for the courses to be of ashlar throughout, and that the stones should be well bonded into the walls, and that they should break joint; these precautions tending to secure the work against the unequal settlements likely to result from the employment of materials of inferior strength in courses in which materials of greater weight and strength are also introduced. The same precautions respecting the surfaces or foundations on which the structure is to rest should be observed; namely, they should all be horizontal. But there
are often other forces to be resisted besides that of the gravity of the mass; namely, the force of the winds and of the waves. These, acting at right-angles with the direction of gravity, are to be opposed by the cohesion and weight, and by the consequent friction, of the materials; from which fact, we may infer that among stones of equal hardness and durability, and dimensions, the heaviest are to be preferred. For the purpose of resisting the lateral pressure of the winds and the waves, cements of various kinds are employed, even in ashlar work, in order to establish some degree of cohesion among the materials. For the temporary security of the work, especially the lower parts, during the course of its construction, dovetailing, joggles between the courses, wooden trenails, &c., may be used whenever the circumstances of the case indicate the necessity of guarding temporarily or permanently against the action of lateral forces. These precautionary measures, however, should exclude the extensive employment of iron unless it is to be well covered, because of its liability to oxidation.

Mortars and cements enter largely into the composition of light-houses, and their accessories, as well for the foundation as for the superstructure. The important subject of mortars and cements, and of concrete and beton, would occupy too much space in this paper. It has of late years occupied a large share of the attention of architects and engineers who have made many trials, and have had a very extensive experience, in their composition and use. Some of these have given able works upon them; and we cannot more safely dispose of the subject in this paper, than by referring to those publications, as guides for such as may have occasion to erect structures requiring the employment of these kinds of materials.

The quality of the sand has a considerable influence upon the quality of the mortar, whether made of lime, of lime and cement, or of cement only, into which it enters as a component; sand should be clean and sharp, and perfectly free from all impurities. The questions, however, which relate to the composition and manipulation of mortars and cements, and the proportions in which the ingredients should be combined, would require too much space in this report, and would be out of place; moreover, they are very ably treated in the publications to which we have referred.

The induration of the usual lime-mortars is attributed to the reconversion of the lime from a hydrate to a carbonate, by dessication and recombination with the carbonic-acid gas, of the atmosphere whilst this particular cause of induration, owing to a difference in its chemical combination, is unnecessary and does not apply to the case of hydraulic cements. In the case of common lime-mortar, whatever its quality, the process of induration proceeds gradually, and very slowly, if at all, from the exterior surface of the masonry, &c., towards the interior. From these facts we might infer, a priori, that the usual lime-mortars could not always harden in very thick walls, however well built, and that therefore they should not be employed in their construction, because manifestly the presence of atmospheric air is not always possible in the interior of such walls, nor the complete dessication. And, accordingly,

"Some curious facts might be mentioned, not only to show the influence of a large body of masonry in retarding the solidification of the mortar
in the interior, but also of the danger of using the rich limes in cases where such masses are necessary. Among them we may mention a fact, cited by General Treussart, who had occasion to demolish in the year 1822 one of the bastions erected by Vauban, in the citadel of Strasbourg in the year 1666. In the interior, the lime, after these 156 years, was found to be as soft as though it were the first day on which it had been made. Dr. John mentions that in demolishing a pillar nine feet in diameter, in the church of St. Peter, at Berlin, which had been erected eighty years, the mortar was found to be perfectly soft in the interior. In both cases the lime used had been prepared from pure limestone.

"Pure water absorbs or takes up all the non-carbonated parts of the hydrates of lime. For all purposes, therefore, in which it is required to build in water, or to expose the construction to the action of that fluid, it is necessary to employ such limes only as absorb the carbonic-acid gas instantaneously. Many instances occur in which works executed with the rich lime have failed, from the fact of all the mortar having been carried away; among others, the locks constructed for the improvement of the navigation of La Vilaine, which fell in, from the cause mentioned."

The water employed in slacking lime and generally in the making of mortars, ought to be as pure as it can be obtained. Sea water ought rarely to be used in making mortars, for such a compound may yield, for an indefinite period of time, the saline effervescence which we sometimes find upon the surface of masonry, and general dampness, external and internal—effects which are objectionable in nearly all situations, but especially in dwellings and in structures where dampness is to be avoided. All mortars, until they have hardened, are deficient in the qualities expected of them as an element of good masonry, and are necessarily exposed to whatever causes of progressive deterioration there may chance to be in their vicinity. Moreover, limes yield less mortar when made with sea water, and the same may probably be said of other impure waters. In cases where it is difficult to procure pure or fresh water in sufficient quantities, or where the cost of employing it in the fabrication of mortars is an element of too much importance to be overlooked, it will be of course necessary to submit to the circumstances of the case, and employ sea water, as is done in the construction of some of the Scotch light-houses, although the objections to its employment are there well understood.

Our attention is especially directed to this matter, because we find that very different opinions from those we have given have been entertained at the Department charged with the care of the light-house establishment. From House Doc. No. 282, 27th Congress, third session, report of the Fifth Auditor, February 13, 1843, we extract the following:

"Treasury Department,

"Fifth Auditor's Office, February 13, 1843.

"Sir: I have the honor to enclose, for the information of the Committee on Commerce, reports made by the superintendents of light-houses in Maine and Massachusetts during the last summer, as to the condition
of the several light-houses under their superintendence, respectively; which show—

"That the mortar used in the buildings constructed of split stone or hard brick was made with fresh water and sand, in the belief that it was more adhesive than if made of salt water or sand; but that experience has proved that the action of salt water and salt air upon it, in a short time has decomposed the mortar and rendered it necessary that the joints be repointed, which has been done during the last year, with hydraulic cement, in regard to all the light-houses in the State of Maine.

"That it appears from the letter of Eliphalet Grover, Esq., who was appointed to oversee the erection of a new tower at Boon's island, to the superintendent of Maine, (page 15,) that in taking down the old tower, which was built of mortar made partly with fresh and partly with salt water, it was discovered that the mortar made with the latter was the most firm and adhesive, and therefore more suitable for light-house towers."

Again, in House document No. 14, thirty-first Congress, second session—report of December 14, 1850—we find:

"Captain Howland in some instances mentions that the mortar with which the towers were built, appeared to be nothing but sand, which crumbled and fell from the joints in buildings erected of brick or stone. He was not aware of the fact, that when these towers were built, it was the prevailing opinion of builders, as well as of this office, that the mortar made of common lime and sand ought to be mixed with fresh water and fresh sand; and consequently, all contracts prior to 1843 provided that the mortar should be so made. In that year, however, finding on the eastern coast that the mortar in towers built near the sea, in a few years was decomposed, crumbled, and fell from the joints, an inquiry was instituted, when it was found that the muriatic acid in the air, arising from the sea, was the cause of the destruction of the mortar made with fresh water and sand."

An English engineer of reputation, recently writing upon the subject of limes and cements, refers to the failure of some works at Algiers and Fort Bayard in the Isle of Ré, at Brest, and at Cherbourg, in all of which, the ordinary lime had been introduced into the composition of the cements which were applied to the work, immersed in sea water, and in which he refers to the investigations of Vicat, as follows: Vicat studied the causes of these failures, and was led by them to some conclusions, which may probably explain not only the disintegration of lime mortars, but also the destruction of some of the building-stone by sea water. He found in the sea water a very considerable portion of the hydrochloride of magnesia, and he proceeded to experiment upon its action upon the hydrates and imperfect carbonates of lime. He found that in a simple solution of the hydrochloride the particles which were already in a state of perfect carbonization remained intact; but that the particles which were simply in the state of hydrates passed into that of a soluble hydrochloride, and that the magnesia was introduced into the mass, and disseminated throughout the whole tissue. It there quickly passed to a state of a carbonate with the greater facility, when any carbonic-acid gas was present. From this, Vicat was led to think
that the imperfectly carbonated parts of the cements, whose failure led to the investigation, must have taken up the magnesia from the sea water, and passed to hydrocarbonates of lime and magnesia, similar to the dolomites, whose formation may, perhaps, be accounted for in like manner. This would, of course, be accompanied by a mode of crystallization different from that of the ordinary carbonate of lime, leading, doubtless, to the disintegration of the whole mass."

The engineer charged with the direction of the works at Rochefort, says: "That besides taking up the magnesia, and passing to the state of a carbonate of lime and magnesia, the mortars at Fort Bayard contained crystals of sulphate of lime. Now, as the sea water does contain a considerable portion of the sulphate of magnesia, it is very probable that the lime may have absorbed the sulphuric acid thus presented, and given rise to the new combination, which, in its turn, must have contributed to destroy the cohesion of the whole body, for the tendency of the sulphate of lime in crystallizing is known to be expansive.

"The practical lesson to be drawn from these researches would be, never to employ the artificial buozzolanois. in the present state of knowledge of this branch of chemistry, for any works of importance where water charged with salts is likely to affect them. It also shows how much care should be taken before employing new compounds in works of importance; for, we see that in these cases no symptom of decay manifested itself during the first three or four years. Such want of precaution is the more culpable * * * when we possess natural cements of such undoubted excellence, and where it would be so easy to procure the best hydraulic limes.

"In further prosecuting the subject of the admission of sea water into the composition of mortars, in the employment of some kinds of bricks or other materials, in which soda or potassa may be present in masonry in damp situations, it is observed that they are often covered with a crystalline substance of a white fleecy appearance, and of a slightly alkaline flavor, which works its way through any ordinary coat of paint; and as it absorbs the humidity of the atmosphere in efflorescing, it renders the walls damp on the surface, and carries off the paint in large patches. This process is called, by workmen, saltpetering, and is in fact the production of a salt from the materials employed in the construction of the walls; * * * moreover, its action upon the durability of stone is such that the study of this singular chemical phenomenon interests the engineer to an equal extent.

"Saltpetre is, properly speaking, a nitrate of potassa; but, although it is regarded as the sole cause of the appearance we now examine, it is far from being the only substance produced in the particular instances, for the nitrate of soda and the chloride of potassium are often to be met with in connection with the saltpetre itself.

"The nitrification takes place very freely when sea water and sea sand have been used, so much as to render them totally unfit for works requiring any perfection of execution. Dumas asserts that there is a very considerable quantity of nitre in the sea salt; if so, it may explain the injurious action of the sea water. Brande, it is true, does not mention nitre as being present in the sea salt; but he states that the earthy
muriates are so in the proportions of between 5 and 28 per thousand, the sulphates between 6 and 32\(\frac{1}{2}\) per thousand. The efflorescence upon works executed with sea water is, however, very distinctly and decidedly a nitrate of soda; and as it occurs in much greater abundance wherever it is used, notwithstanding Brande's silence, we may safely assume that some portion, at least, of the nitre is furnished by it.

"The practical bearings of this interesting chemical question, upon the professions of the engineer and architect, are as follows:

"Firstly: sea water, or sea sand, should never be used in making up mortar or plaster, which is likely to require painting or any sort of decoration. For outside works, the use of sea sand which has been well washed in fresh water and exposed for at least six months, may be admitted, but it is still likely to cause a nitritification; and as the conditions of temperature internally are more favorable to that action than externally, it is most likely to manifest itself in that direction. There is always a danger attending the use of sea sand; if it can be replaced, it should therefore be so, even at an increased expense."

The preceding quotations have been introduced to show the adverse opinions of authorities in relation to the use of salt water in mortars; and though the theory of the subject is not yet entirely agreed upon, and there are certainly some diversities of opinion as to the chemical causes of some of the effects mentioned above, there is in these effects a general analogy to experience in our own country. And the "saltpetering" spoken of is not unfrequently seen with us in structures corresponding to those just described. But we have another and even a worse kind, which is due to the presence of soda or potash, one or both in the hydraulic cements derived from most of the northern manufactories.

These alkalies in solution, and accompanied perhaps by other salts, being first absorbed from the mortar by porous bricks or stone, afterwards effloresce, throwing off successive scales from the surface of the stone or brick. This difficulty is a serious one in brick-work laid in hydraulic mortar, and is another reason for using with these mortars only the hardest and least absorbing brick. Very hard and dense bricks, and sound building stone, are not affected by this efflorescence. The mortars made of our hydraulic limes or cements, with or without common lime, according to the nature of the work, and of the exposure, are excellent, and without other objection than that mentioned. And these limes and cements are so abundant in the United States, and so distributed with reference to the facilities of transportation, and comparatively so cheap, that there can be but little reason for not using one or the other in works of magnitude or importance, for which other limes would be unsuitable or less efficient, whether for the foundation or the superstructure in the body of the work or for its exterior protection or decoration.

By the term *hydraulic lime*, used above, is meant a lime in which there is naturally a small proportion of constituents which impart the property of hardening, *though slowly*, under water. And by *hydraulic cement* is meant a compound (containing a small portion of lime) that, being duly prepared, hardens very *quickly* under water.
In most of the light-houses visited by us, we have found the masonry extremely faulty.

The large number of towers that it has been found necessary to rebuild, and the dilapidated and dangerous condition of others, and the large expenditures required annually for repairs, will bear us out, as we have once before remarked, in this judgment. The objection to the masonry applies to the form, dimensions, quality, and preparation of the stone, and the composition and quality of the mortar; the former of which is, in most cases, employed apparently without selection, and without any knowledge or care as to its fitness for the work. The latter material being often at the same time nearly or quite destitute of adhesion, crumbling almost as freely as if it were clear wet sand, the stones maintain their position in the wall by reason of their gravity alone, and the resulting friction.

Elsewhere in this report we have spoken of the foundations, and have devoted but very few words to the subject, not because we are not fully impressed with the conviction of its importance, or because we have had but few words to say upon it; on the contrary, the subject is so important and fruitful, and offers so many points deserving attention, that it would be impossible to give even an instructive outline without devoting a space to it wholly inadmissible in a report necessarily so general as this. On the sufficiency of the foundations depends, above all, the security and stability of the superstructure. The foundations may be originally solid or yielding, wet or dry, in stagnant or in running waters; or the materials of which they are composed may be of rock, scarped or floored, or of solid earth, or gravel, or they may be of movable sands swept by the currents, or, finally, soft or yielding to unascertained depths, and incapable of sustaining any great weight. Each of these cases (and others not enumerated) requires its special mode of treatment, and all of them require experience, intelligence, and care in their management. Moreover the plans and the process of the erection of superstructures are liable to be modified and influenced by the character of the foundations; meaning by this word, the base, natural or artificial, upon which the superstructure rests. In some of the cases we have enumerated there are characteristic difficulties which oppose themselves to the skill of the engineer, and which call for all the resources of his genius and experience. For all of them there have been devised general methods, by which they may be treated, but they all require to be modified in order to adapt them to special localities. It would not suffice, therefore, to prescribe general rules already well known to the profession. We should leave for the occasion, to competent engineers, the consideration of the peculiarities of the special cases, and the remedies applicable to them. To them they should be intrusted, under the control of some sufficient system of supervision.

We do not deem it necessary to speak at this time concerning the plastering, stuccoing, painting, or other superficial means of protecting or decorating the exterior or interior of light-houses; these may well be postponed to a future occasion. The lanterns, lighting apparatus, lightning-rods, and other matters relating to the subject of construction, &c., not noticed in this part of the report, have been already discussed by the board, and will be found elsewhere in their report.
ILLUMINATION.

On a review of this subject, the board recommends the adoption, as early as practicable, of the lens system instead of that of reflectors, as most effective and economical.

They have shown, in a previous part of this report, that the Fresnel lens is essential for sea or lake-coast lights of the first order; that for those of the second order, or for secondary or beacon-lights, including the third, fourth, fifth, and sixth orders, the useful effect of a lens light is from 3.6 to 4 times that of reflector lights of the same class, and that, economically, the reflector lights are four times as expensive for oil alone as the lens lights.

It has been clearly shown, in discussing this matter, that if it were possible to convert in a moment all the present reflector lights of the United States into lens lights as nearly as possible (though, in almost every instance, they would be superior) of equal orders, the annual saving, for oil and other supplies, would be $112,185 27, taking the appropriations of 1851-52 as the basis of the calculation, with, at the same time, an increase of $3 1/4 to 4 times as much light from each lantern as at present.

If the estimates for 1852-53 be taken as a basis, then the annual saving may be increased $20,000, which will make the entire saving for one year, with all the advantages to be derived from superior lights, $132,185 27.

Add to this sum $40,000, the mean of the value of the lamps and reflectors proposed to be taken from the light-houses, to be fitted first with the lens apparatus, and which would be required, under any circumstances of improvement, for the forty-two light-vessels already existing, and the sum of $172,185 27 may be put down as clear profit, with which to purchase lens apparatus for the first year.

By appropriating this sum, or as much of it as can be economically and judiciously employed in improving the sea-coast lights, there will be an additional gain, at the end of the first year, in the difference in the cost of oil &c., under the two systems, for all the apparatus procured with this saving. This saving will go on from year to year, on compound interest, at the rate of thirty to fifty per cent., until, in five or six years, should the appropriations be made as required to carry out gradually the system, we shall have lights equal to those of France and Great Britain in brilliancy, useful effect, and economy, and apparatus that never requires renewing, without, in the aggregate, having spent one cent more than would have been required for the ordinary service under the present system, with inferior lights and enormous sums for annual repairs and renovations.

These estimates are based upon the assumption that the sperm oil now in use is to be continued. Should it be decided, however, to follow the example of nearly the whole maritime world in introducing the colza or rape-seed oil, a saving of thirty-five to forty cents per gallon will be gained, equivalent to $40,000 to $45,000 more.

Note.—The price of the first-quality clarified colza oil is, on an average, at the principal markets in France, 72 francs the hectoliter, or for
a little more than twenty-six gallons, which is equal to nearly 55½ cents per gallon. Sperm oil, in this country, ranges from $1.30 to $1.50 per gallon, and it is doubtful if a fair quality can be furnished at these prices. The supply of the best sperm oil, to stand a temperature of 28° Fahrenh·it, is not equal to the demand, and no other quality should ever be burnt in a light-house. A few gallons of rape-seed oil has been sent from Havre to the board, costing about 60 cents per gallon.

This important agricultural product (rape-seed) only requires to be introduced favorably to the notice of our planters and farmers, to become a boon to the nation of no ordinary value. Adapted to the soils of nearly every portion of this great country, its admirable qualities for domestic illumination would soon bring it into favor, and, by its means, expel from our houses the many dangerous fluids now used for the sake only of economy.

The experiments made by Fresnel, Faraday, Stevenson, and other distinguished individuals, have proved, beyond all question, that the colza is not only better than the best sperm oil, (an article now very difficult to procure,) but that it will burn seventeen hours without coaling the wicks, that it will remain in a fluid state in a lower temperature than the best sperm oil, and that it is cheaper by nearly one-third.

In this country, the quantity of sperm oil, independently of its high price, has not been sufficient to meet the demands for the various purposes connected with steam machinery, &c., for several years. Lard and other prepared oils have been forced to take the place of it, for these and other purposes for which it is peculiarly adapted.

The returns from the fishing grounds show that this branch of commerce is becoming more and more uncertain, and less profitable, every year. When those engaged in the whale fisheries find it unprofitable, they will not pursue it because the Government may require a few thousands of gallons annually. We cannot go wrong in this matter, in following the example of other countries.

France introduced the rape-seed oil, from conviction of its superiority. England, Scotland, Ireland, and the northern powers of Europe generally, have followed: first from motives of economy, and continue its use from the conviction that it is not only more economical, but is better for light-house purposes than the best winter-strained sperm oil, the only kind used in most lights. Olive oil has been introduced into the light-houses of Liverpool, England, at a saving of forty per cent. over sperm oil.

In the United States, the oil (two kinds, "winter and summer," being used) for our lights, is not of the best quality. It is now nearly fifty per cent. higher in price than it was a few years since; and with the present prospects, it must continue to increase in price so long as the demand is so great for it, as at present.

It has been proposed that the thirty-eight most important sea-coast lights should be fitted, with as little delay as possible, with first-order lenses, and that the Argand lamps and reflectors taken from them (or such of them as may, upon examination, be found to be sufficiently good for that purpose) be used for fitting up the forty-two light-vessels now existing, which have been pronounced by high authority comparatively
useless in their present state. Several years would be required to effect this change, as the new lights authorized by law, amounting to thirty-four, exclusive of those for the coasts of California and Oregon, require illuminating apparatus; and as there are only two establishments from which the lenses could be procured, for some time at least, it would not be prudent to demand a larger number at once than could be easily supplied.

It is the opinion of this board, that with the authority of the law at present existing, if it be determined to abandon in good faith the reflector and substitute the lens system in this country, a very small increase of appropriation for purchasing lenses, for renovating existing light-houses, would suffice to effect a sufficiently gradual change; but as no lens apparatus has hitherto been introduced into the United States, except by special acts of Congress, although the authority to introduce the best illuminating apparatus has always existed, and as the board deem it of the first importance to introduce, without unnecessary delay, first-class lens lights at some of the most important points on our extended sea and lake-coast, they would urgently recommend a sufficient additional appropriation to enable the Secretary of the Treasury to order apparatus for them at once. These lights will be spoken of more in detail in the general programme in this report. The Government of France having a general supervision over the fabrication of this apparatus, a fixed tariff of prices is published for every piece of which it is composed, which forbids the possibility of imposition on the part of the manufacturer. Under these circumstances, it becomes simply a matter involving length of time, and money, to effect the proposed change without detriment to the public interest.

Having fitted the most important sea-coast lights with the best lens apparatus, as well as the newly authorized lights, by changing thereafter such only of the minor lights as now, or hereafter, require new apparatus, would in two or three years place the light-house establishment of this country far in advance of its present state, in efficiency and economy.

To purchase Argand lamps and reflectors for the forty-two light-vessels, would be to retrograde in light-house illumination at a first cost of $40,000 to $45,000, and an annual waste of $7,560 for oil alone; and of the supplies, to the extent to increase the amount to $10,000, with apparatus which must be frequently renewed, producing only from one-fourth to one-sixth the usefulness of the less economical system, which never requires renewing.

Taking the estimate for 1852-53 for maintaining the lights of this country as a basis, the present system costs annually within a fraction of $135,000 more than the same lights would under the lens system. But in so important and humane a branch of the public service as this is, upon the efficient and proper management of which depends, in a greater or less degree, the loss of human life and property, in which every individual in the land is to a certain extent interested personally, mere saving of money, which is by no means always true economy, should not be the only guide. The incalculable benefits to the seaman; the merchant, who receives the foreign products to gratify the wants of our
citizens; the planter, who ships his cotton, tobacco, grain, breadstuffs, provisions, naval stores, and the thousands of products of our clime to the best markets, would seem sufficient to show the necessity for this change.

By those of our citizens along our southern coasts, from the mouth of Delaware bay to the Rio Grande, who are now and have ever been suffering in consequence of a badly lighted coast, will this additional reason be best understood and appreciated. Their freight lists and heavy insurances speak out truly on this point.

The $7,000,000 worth of property sent into Key West, and there adjudicated for salvage within the six years prior to January, 1850, (lost to our citizens and our Government chiefly,) speaks trumpet-tongued on this subject. But this is not all. The wreck lists of Nassau and New Providence exceed by far those of Key West.

Let us light our coasts as France and Great Britain have done theirs, and wreckers will be compelled to turn their attention to other means of livelihood, and the consumers of every class and grade will pay less for their necessaries and luxuries. and the planter, farmer, and mechanic will have smaller freight and insurance bills to pay on their exports.

If we assume the necessity for changing all the lights on our coast to lens lights, and give to each one of them its proper power and efficiency, we should have about as follows:

Thirty-six first-order lens lights, costing for apparatus... $244,800 00
Ten second-order lens lights. costing for apparatus........... 44,000 00
Sixty-one third-order lens lights, costing for apparatus.... 113,460 00
Two hundred and six fourth, fifth, and sixth-order lens lights, costing, in the aggregate, about.................. 92,700 00

Total amount necessary to purchase lens apparatus for all the lights in the United States......................... 494,960 00
Deduct value of reflectors and lamps for light-vessels at present existing, and for proposed ones.......................... $45,000 00
Deduct value of present illuminating apparatus, lamps, reflectors, chandeliers, &c., merely estimating the value of the old silver, copper, and iron, say 2,500 lamps and reflectors and 315 chandeliers, at one-fifth their cost.............................. 50,000 00
Deduct first year's saving on oil and other supplies........................................... 110,000 00

205,000 00

Leaving at the end of the first year, with lenses, only a balance of.................................................. 289,960 00
Saving for four years.............................................. 440,000 00

Making a gain, at the end of the fifth year, of....... 150,040 00
Thus, at the end of the fifth year the country will have gained $150,000 in money, including interest, and an annual saving of $110,000, the interest of which will make it $117,600, and afford to the mariner lights equal to the best in the world, by which means every consumer and exporter will derive a pecuniary advantage; and those who go to sea, either from pleasure or necessity, will be doubly insured against shipwreck on our inhospitable coast.

To make the reform in our present light-house system perfect in its illuminating department, it only remains to introduce, in addition to the lenses, the colza or rape-seed oil, which will produce an additional saving, as has already been shown, of about $10,000 per annum; making the grand total, in five years, of $200,000. It may be contended that, inasmuch as interest is included in the saving, it is but fair to allow it on the first cost, which will be, at the end of the Second year ........................................... $15,397 60
Third year ..................................................... 8,797 60
Fourth year ..................................................... 2,197 60
Making for interest ............................................. 26,392 80

Still leaving a net gain, at the end of five years, of $132,647 20, without taking into consideration the saving from the rape-seed oil, if introduced, which would increase it to $182,647 20 of clear gain at the end of five years, in addition to the annual gain and other advantages already stated.

But if we continue to employ reflectors, such as we have now in use and are constantly introducing into our lights, we will not only lose the amount annually which has been shown we should gain with lenses, but in addition to that, these reflectors and lamps will require to be renewed once in ten to fifteen years, at a cost very little short of that of the lenses, which suffer no deterioration from long use, and humanity and commerce will continue to suffer for want of good and efficient lights on our coast.

INSPECTION.

The board is satisfied that without a rigid system of inspection by competent persons, the light-house system can never be efficient or economical. The whole sea and lake-coasts of the United States should be divided into light-house districts, with less regard to geographical than to local lines. For example, the New York district should embrace all the lights from Watch Hill, including Block island, Montauk point, &c., to the Highlands of Navesink, up the bays, and including the Raritan, Hackensack, Passaic, and North rivers, to the head of navigation. The Philadelphia or Delaware bay district should embrace coast from the Barnegat to near Assateague, and up the Delaware on both sides to the head of navigation. The Baltimore or Chesapeake bay district should embrace all the coast from Assateague to Cape Henry, Hampton Roads and tributaries, and Chesapeake bay and tributaries, to the head of navigation. The other districts should be formed upon the same principles. In each of these districts there should be a local inspector, who should be furnished with the necessary means and facilities for regu-
larly inspecting the lights, attending to the wants of the keepers, super-
intending small repairs, reporting the condition of the establishment, at
short intervals of time, to the executive officer or engineer of the Light-
house Board, superintend the placing, replacing, and renovating buoys,
beacons, &c., under the general and special instruction of the Light-
house Board, communicated through their executive officer or engineer.

For this purpose there would be required on the lakes two inspectors,
and on the Atlantic, Gulf, and northwest coasts, including all the adja-
cent navigable waters, from ten to thirteen inspectors more, making the
whole number required from thirteen to fifteen.

Each of these light-house districts should be placed under the charge
of an active and zealous officer of the Army or Navy, who should re-
ceive all his instructions from, and be responsible to, the Light-house
Board, through their executive officer or engineer, and to whom all re-
ports should be made.

The facilities for inspectors superintending such repairs, &c., as may
be confided to the local inspector, to be furnished by the light-house
vessels, revenue cutters, and such other means as the Treasury Depart-
ment may from time to time authorize the board to provide.

By this mode of inspection, very little, if any, additional expense will
be incurred, while there will be secured an independent examination of
every light on the coast, say from four to six times per annum, by a
competent person, whose duty it will be to inform himself upon all essen-
tial matters connected with this service. In addition to the foregoing
means, the revenue boarding-boats might and would be appropriately
put in requisition as occasion might require, to assist the inspector in his
duties in situations where a strict economy would not authorize the em-
ployment of a vessel permanently to perform this service.

Instead of, as now, contracting with persons to keep the buoys in their
places for a certain sum per annum, and who seldom, if ever, perform the
service faithfully, the inspector would, under proper instructions, be re-
quired to examine the bars, channels, &c., of his district, at regular
periods, and always immediately after heavy gales of wind to ascertain
what buoys are out of position, and to replace them.

The inspecting officers would occasionally be accompanied by the sec-
retary or engineer to the Light-house Board, or perhaps by both of them;
a thorough system would be provided, which would inevitably be less
expensive in the aggregate than at present existing without specific
law.

In connection with these inspections, depots for stores, spare buoys,
moorings, &c., are indispensible in each district. These depots might,
in most places, be at some place requiring but little annual expense,
where the buoys and their moorings could be repaired, painted, &c., and
where a spare light-vessel might be kept ready for use.

There should be at least one spare light-vessel for every three placed
in exposed open-sea positions.

Duplicate buoys and moorings should be ready at all times.

The Light-house Board should have authority to cause buoys to be
placed on newly-discovered shoals, wrecks, &c., whenever necessary.

By the employment of these inspectors, the country would derive the
benefit of their services without expense, and have an assurance, from their position and standing, of a faithful execution of their duties.

The board would refer again to the reports of the Committees of Commerce of the Senate and House, already pointed out in this report, on this important branch of the lighting service. (See Senate document No. 448, first session Twenty-ninth Congress, &c.)

In connection with this recommendation, the board would advise that light-keepers be examined, as naval engineers, midshipmen, and cadets are, in reference to qualifications for their appointments; that they should not be allowed to take charge of the lights without suitable preparation; nor the more important lights without proportionally higher qualifications; that such meteorological and tidal observations be required of them, in addition to the keeping of suitable registers of lighting, consumption of supplies daily, &c., as may tend to test the capacity of the keepers, and to elevate the standard of information and practical skill of them as a class.

SUPERINTENDENCE.

An efficient provision of lights, and other aids to navigation, along our coast, competent light-keepers, and able and zealous inspectors, will not suffice to carry out perfectly the wise and humane designs of Congress and of the nation, unless there be provided a bureau or board in the Department, thoroughly organized, charged with all the general and detailed duties of an administrative and executive character, appertaining to the Light-house Establishment.

To effect this highly important object without incurring additional expense, the board have recommended that a permanent board be authorized, under the name and style of the "light-house board," to be composed of civilians, military and naval officers, whose prerogatives and duties shall be defined by law, to be executed under the orders and direction of the Secretary of the Treasury; the members of said "light-house board" to serve without other compensation than that now, or that which may hereafter be, authorized by law for their services in their respective civil and military offices held by them under the Government. (See ante part of this report, page 17.)

GENERAL PROGRAMME

To guide legislation in extending and improving our present system of construction, illumination, inspection, and superintendence.

The seventh section of the act making appropriation for light-houses, light-boats, buoys, &c., approved March 3, 1851, provides, "That hereafter, in all new light-houses, in all light-houses requiring new lighting apparatus, and in all light-houses yet unsupplied with illuminating apparatus, the lens or Fresnel system shall be adopted, if, in the opinion of the Secretary of the Treasury, the public interest will be subserved thereby."

The board are of opinion that this is a wise provision, and recommend
that it be carried out to the letter, and in the spirit, by the Department. There are very few cases, in the opinion of the board, where the public interest will not be greatly subserved by the substitution of the Fresnel lens for the reflectors now employed in illuminating our light-houses. In positions where the light is only required to illuminate a small arc of the horizon, it may be of questionable propriety; but in all such cases, the capable light-house engineer should decide upon the merits of the two kinds of apparatus. In no case requiring one-half or more of the horizon to be illuminated, is it believed reflectors ought to be employed in preference to the lens. There may be occasionally circumstances of a paramount character, which may render the employment of reflectors preferable.

The ninth section of the act approved March 3, 1851, provides, "That the President be, and he is hereby, required to cause to be detailed from the engineer corps of the Army, from time to time, such officers as may be necessary to superintend the construction and renovation of light-houses."

The board are of opinion that this act is one calculated to produce the most beneficial results, in increasing the durability of light-house structures, and consequently lessening, to some extent at least, the present large annual appropriations for renovations and repairs; and they recommend that no new structure be erected, and no old ones be repaired, except under the superintendence of a competent officer of the corps of engineers.

The board are of opinion, that pending the action of Congress upon the subject of improving our lights, &c., much may be done towards introducing a more efficient and economical administration of the establishment, by a rigid adherence to the provisions of the seventh and ninth sections of the law of 1851.

The board are of opinion, that early and special attention should be given to these points, by those at present charged with the management of our lights, buoys, beacons, &c.

**LOCATING OF SEA AND LAKE-COAST LIGHTS.**

The board have adopted the same principle which has proved so effective in the organization of the French system of lights—namely, to place a sea-coast light of the first order, in general, every forty-two nautical miles, so that, as a rule, one light will not be lost sight of until another is above the horizon. If it should be necessary to adopt only two main systems of distinction for these lights into fixed and revolving, then a fixed light should be placed between two revolving lights, suitably distinguished by flashes, &c., so that no two lights of the same kind should be nearer than eighty-four miles from each other. Other distinctions, easily described in the published lists, and easily comprehended by navigators, which would render all fear of mistakes arising from the want of proper distinctions illusory, (and without the use of colored media,) can be employed. If, however, Mr. Babbage's system prove to be practicable, and be adopted, all doubt in regard to distinctions of light will be obviated. The board have adopted an approximate programme, in this re-
port, for the sea and lake-coast lights, the number of which is necessary to a full system. Of these many now exist, though not with the requisite range of visibility. There are many locations where the wants of commerce will not require such lights for many years, though necessarily included in a general programme.

Provision should be made by degrees for converting the present lights into lens lights of the first order, placed on towers sufficiently high to give a range of at least twenty nautical miles, commencing with those of most importance to commerce, and taking also into consideration the present condition of the apparatus in the towers. Detailed lists of these lights are appended, marked A, B, and C, and their importance may be considered in the order in which they stand.

List A contains all the sea-coast lights at present existing, which require to be fitted with lenses of the first order, and arranged in the order of their importance.

List B contains all the new proposed lights of importance, and relatively as they stand upon the list.

List C contains all the sea-coast lights at present existing which require to be made first-order lens lights, and such as are necessary to be built to carry out the plan proposed by the board, in the order in which they stand along the coast. The detailed description of each locality will exhibit the relative importance of the lights on the several lists.

It is to be understood, of course, that distances between two adjacent sea and lake-coast lights of major importance, will be varied, within the general rule, to suit circumstances of locality, importance of positions, &c.

The board propose that the improvements and constructions of the new lights, contained in the lists A, B, and C, hereto appended, shall be gradual, taking them in their order of importance to the present state of commerce and navigation. Many of the proposed new lights on the Pacific coast, and of Florida and Texas, may not be required for many years. Those from the Dry Tortugas to Cape Canaveral are considered to be of the first importance, and should be authorized without unnecessary delay. The lights at the mouths of the Mississippi are second only to those from the Highlands of Navesink to Charleston, S. C.

A.

List of existing sea-coast lights which require to be elevated, and to be fitted with first-order lens apparatus, arranged in their order of importance.

1. Cape Hatteras, North Carolina.
2. Cape Florida, Florida.
3. Dry Tortugas, Florida.
5. Cape Romain, South Carolina.
7. Cape Henlopen, Delaware.
9. Gay Head, Massachusetts.
12. Cape May, New Jersey.
15. Cape Lookout, North Carolina.
17. Charleston, South Carolina.
18. Tybee, Georgia.
19. Amelia island, Georgia.
20. Sapelo island, Georgia.
22. Pensacola, Florida.
27. Cape St. Blas, Florida.
28. Chandaleur island, Louisiana.
29. St. Mark's, Florida.
30. Off Vermillion bay, Louisiana.
31. Truro, (Cape Cod,) Massachusetts.
32. Seguin's island, Maine.
33. Mount Desert Rock, Maine.
34. Thatcher's island, Massachusetts.
35. Matinicus Rock, Maine.
36. Boone island, Maine.
37. Petit Menan, Maine.
38. Egmont Key, Tampa bay, Florida.

B.

List of sea-coast lights proposed to be built, arranged in the order of importance with reference to time of construction, relatively one to another.

2. Great West bay, Long Island, first-order lens.
5. Fifteen miles north of Indian River inlet, Florida, first-order lens.
6. Hunting island, South Carolina, first-order lens.
8. Currituck, (half-way between Cape Henry and Body's island,) first-order lens.
10. Galveston bar, Texas, first-order lens.
11. Raccoon point, Louisiana, first-order lens.
12. Matagorda island, Texas, first-order lens.
15. Sabine bar, Texas, first-order lens.

PACIFIC COAST.

18. Point E. 5 N. of Farallon, first-order lens.
19. Cape Mendocino, first-order lens.
22. Point Esteros, first-order lens.
23. Cape Blanco, first-order lens.
24. Trinidad, first-order lens.
25. Cape Foulweather, first-order lens.

ATLANTIC AND GULF COAST.

27. New River inlet, North Carolina, first-order lens.
28. Cape Romano, Florida, first-order lens.
33. Dead Man's point, Florida, first-order lens.

ARRANGEMENT INTO ONE SYSTEM IN REFERENCE TO CLASSIFICATION.

The board recommend the following classification of lights, according to their positions, uses, &c.

1. Main coast lights for the most prominent points on the coast.
2. Secondary lights for the inferior points on the coasts, and in broad sounds, bays, &c.
3. Minor sounds and bays, and for harbor and river lights.
4. Range, beacon, and pier lights.

Also into six classes, according to the dimensions of the lighting apparatus and the range of the lights.

All the main sea-coast lights should be of the first order, and the classes to which the secondary, sound, bay, harbor, river, range, beacon, and pier lights should belong, would be determined by the Light-house Board, according to the locality, objects for which placed, &c. This applies to new lights, and to the gradual replacing of the old ones as they may require renewal.

It is believed that many of the present lights might be dispensed with if effective ones were substituted for those now placed on important points, but not of sufficient power and range, which would in the end produce a considerable saving.
DISTINCTIVE CHARACTERISTICS.

The experiments of the board will enable them to make positive recommendations in regard to this important subject. The light-houses and vessels, as well as the lights, should be distinguished from each other by sight, as well as, in case of fogs, by sound.

Colors should only be used for distinguishing small lights of short range, as river, pier, beacon, or range lights. In employing colored media at all for lights, it is important that the most approved modes, with the best quality of appliances, only be used; a duty which should devolve upon professional men.

Mr. Stevenson enumerates the number of distinctions, of which reflecting lights are susceptible, as nine: First, fixed; second, revolving white; third, revolving red and white; fourth, revolving red with two whites; fifth, revolving white with two reds; sixth, flashing; seventh, intermitting; eighth, double fixed light; ninth, double revolving white lights; to which may be added, tenth, double, one fixed and one revolving. Of these, three depend on color and should be discarded, reducing the distinctions to seven.

In the Scotch lights, by causing a rapid revolution of the frame, and placing the rims of the mirrors of each side in one vertical plane, while their axes are in a plane inclined to the vertical, flashes are produced every five seconds, which appear to rise and sink. The intermitting light suddenly appears, is steady for a short time, and then disappears suddenly. These changes are produced by the vertical motion of circular shades in front of the reflectors.

The different characteristic combinations in the lens system, according to M. L. Fresnel, are nine: First, flashing at the interval of a minute; second, flashing at the interval of half a minute; third, white and red flashes alternating; fourth, fixed lights flashing every five minutes; fifth, flashing every three minutes; sixth, every two minutes; seventh, fixed white lights with red flashes; eighth, fixed white lights; ninth, double fixed lights. These are applied only to the first three orders of lights.

In England the lights are classified as sea-coast, secondary, and harbor and river lights.

In France they are divided into six orders, according to their range and the size of the lighting apparatus; the first order being the largest, and the second, third, and fourth orders being each divided into two classes, the larger and smaller, or first and second classes.

The objections to colored lights are, the large absorption of the incident light, and the difficulty of distinguishing the color. Red is admitted to be the best color. A good red light is seen sixteen miles, and sometimes twenty-two. Green lights from a powerful apparatus, in Mr. Stevenson’s experiments, were seen seven miles in very clear weather, and blue lights only five.

The objections to red are—

1. The great loss of light by absorption. A full red glass, used as a chimney of a lamp, absorbed eighty per cent. of the whole. A pink French glass absorbed but fifty-seven per cent. of the light, but the light was not characteristic.
2. White lights grow reddish in a fog. In a revolving light, showing alternately red and white, the red is absorbed at a less distance than the white and the light may be mistaken for a white light of half the period of revolution.

Two lights will appear blended in one, which are not separated by at least $3' 18''$; call $H$ the required distance between the lights in feet, $\triangle$ the observer's distance in feet, $\varnothing$ half of $3' 18''$. Then $H = 2 \triangle \tan \varnothing$.

For one mile, $H = 5.84$ feet, and for $n$ miles $H = n \times 5.84$.

Leading, or range lights, should be nearly on the same elevation, so as to cause them to appear nearly, but not quite in one. The distance between them should not be less than one-sixth of the distance at which they are thus to be used.

In forming a programme for lighting the coast, the following conditions should be realized:

1. The most prominent points should be first lighted.
2. Revolving lights, as more powerful than fixed, should be used, when possible, on the projecting points.
3. Lights identical in appearance should not occur within eighty to one hundred miles of each other.
4. Distinctions of color should not be adopted, except in cases of absolute necessity.
5. As few lights as possible should be used, not only for the sake of economy, but to avoid confusion.
6. Distinctions of lights depending on the estimations of small differences of time, of appearance and disappearance, should never be resorted to.
7. Harbor or local lights should generally be fixed, and may be distinguished by colors.
8. Floating lights should never be used, when fixed lights can be employed.

The system proposed by Charles Babbage, Esq., of London, and which has been communicated by its distinguished author to the board, at the request of one of its members, is to distinguish lights by occultations; or, to make each lighthouse repeat its own number continually during the whole time it is lighted.*

This is accomplished by enclosing the upper part of the glass cylinder of the Argand burner by a thin tube of tin or brass, which, when made to descend slowly before the flame, and then allowed suddenly to start back, will cause an occultation and reappearance of the light.

The number belonging to a lighthouse may be thus indicated to distant vessels. Take as an example, 243.

1. Let there be two occultations.
3. Four occultations.
5. Three occultations.
6. A longer interval of time.

*Communication from Charles Babbage, Esq., to the Light-house Board, (Appendix BB.) The board were indebted for an early notice of this ingenious and important proposition to Dr. B. A. Gould, of Boston, who kindly described it, and forwarded a proof-sheet of the chapter in Mr. Babbage's work on the London Exposition, which contains a notice of it.
This system of occultations may be repeated all night by means of proper mechanism.

The rapidity of the occultations themselves, the length of the pauses between the units and tens and between the tens and hundreds, as well as the duration of the long interval of time which marks the termination of the number, must be made the subject of experiment.

A light has been already used as an illustration, in which the occultations occurred at intervals of one second; the pauses occupied four and the long intervals ten seconds. The pause was thought to be unnecessarily long, and was diminished. Whatever may be the times ultimately adopted, the experiments already made render it improbable that the average time required by a light-house for repeating its number should amount to one minute.

It is by no means necessary that the counting of the number of a light-house should commence with the digit which expresses hundreds. No greater amount of time would have elapsed, if, in the above instance, the observer had commenced with counting the unit's figure. It would then have read thus: (three occultations;) long interval; (two occultations;) pause; (four occultations;) pause.

By the long interval denoting the commencement of a number, it is already apparent that the number of the light-house is 243, and not 324.

In order still further to prevent mistakes arising from an incidental error in counting the number of occultations, it will be convenient to establish another principle for the purpose of numbering the light-houses.

Light-houses must not be numbered in the order of their position; but every light-house must have such a number assigned to it, that no digit occurring in the number denoting the several light-houses nearest to it on either side shall have the same digit in the same places of figures.

If five adjacent light-houses were thus numbered:

361, 517, 243, 876, 182:

supposing a mistake to have occurred in the first time of counting 243, and that it had been reported to the master of the vessel as 253, he would immediately, on looking at his numerical list of light-houses, perceive that a mistake had been made in the middle figure; because, in any general arrangement, 253 would have been assigned to some light-house on a coast very distant from that on which 243 was placed. In fact, two out of any three figures would always detect the error of the third.

The occultations would distinguish every light-house from all casual lights, and their number would identify the light. The whole illuminating power would be always employed, undiminished by the interposition of colored glass. These lights would be more readily visible at a distance, because it is known that the eye perceives more readily a faint light which is intermittent, than an equal light which is fixed.

The board regard this as the most important proposition for distinguishing lights which has ever been made, and propose to make full experimental trials of it.

In fogs, Mr. Babbage proposes to make the pauses between the strokes of the gong take the places of the occultations of the light.
To give this great plan a full development, all nations should unite in a system of numbering for light-houses. Such a co-operation might reasonably be looked for, if the plan have all the success which is now expected.

The entire communication of Mr. Babbage to the board will be found in the Appendix BB.

**BEST MODE OF ASCERTAINING THE NECESSITY FOR INTRODUCING NEW LIGHTS, BEACONS, &c.**

Legislation is of course necessary to the establishment of a new light. The recommendations of the Light-house Board, of officers of the Coast Survey, of pilots, navigators, and others, all reach the Committees of Commerce of the two houses of Congress; through different appropriate channels.

It does not seem practicable to propose any system of examination of sites which would not be very expensive, while legislation is pending on the subject. A reference to the Light-house Board, in doubtful cases, would secure the committees from recommending appropriations for objects which certainly would not have the approval of professional men.

The law of the last session provided for the examination of sites, for which appropriations were made, (vide appendix,) by the officers of the Coast Survey, and a report by the superintendent. As this will leave a full knowledge of all the circumstances of the case, and be attended with very little expense, the board recommend that the same plan be pursued in all future cases.

**BEST MODE OF SUPPLYING NEW LIGHTS.**

When it has been shown, to the satisfaction of Congress, that new lights are required, and appropriations made for the purpose, the plans and specifications for construction, illuminating apparatus, distinction, &c., should be made by the engineer of the Light-house Board.

Should a previous estimate have been made by this engineer, for the information of Congress, generally, there will be required but little more than to fill up the details.

The construction having been approved by the Light-house Board, a contract should be entered into, according to law—based entirely upon the plans, drawings, and specifications and estimates of the engineer—and the building should be erected, and the lighting apparatus and accessories be procured, under the inspection of the engineer of the board, or of such officer of the corps of engineers of the Army as may be detailed for the purpose, in conformity to the 9th section of the act approved 3d March, 1851.

All the details should be subject to similar inspection.

**MODE OF RENOVATING LIGHTS.**

Whenever the Light-house Board is satisfied of the necessity for renovating any existing light, by the introduction of better illuminating
apparatus, &c., the engineer of the board should be required to prepare estimates and plans in detail, to be submitted to the board, which should be passed upon, and, if approved, the necessary steps should be taken to make the repairs, &c., according to law; or in the event of the expense being too great to admit of the works being done, except by a special appropriation, then the necessary estimates, explanations, &c., should be prepared and submitted, through the Secretary of the Treasury, for the consideration of Congress.

It should also be the duty of the board to procure all the necessary information relating to the establishment of new lights, abolition of old ones, &c.; to be accompanied by estimates of cost, to be submitted, through the Secretary of the Treasury, to Congress, at the commencement of each session.

DISCONTINUANCE OF UNNECESSARY LIGHTS.

The steps in regard to the discontinuance of lights should be similar to those necessary in cases of renovation of lights.

SUBJECTS OF INSTRUCTION TO EMPLOYEES.

Inspectors and light-keepers should be provided with printed instructions, in the form of manuals of instruction, as well as those necessary to guide them in the police of the establishments, similar to those provided for the inspectors and keepers of light-houses in France and Great Britain. This manual should embrace a detailed account of the modes of executing every part of the duties confided to the inspectors and keepers; a description of the parts of the machinery employed; and the means to be employed, in case of accident to the machinery, &c., until it can be repaired. The instructions for the light-house service of France embrace every point in the most minute detail, and serve not only for the guidance of the inspectors and keepers, but also of the engineers and others in any way connected with the service. The instructions for light-houses, light-vessels, &c., of England, are full and explicit; printed in large type, with conspicuous headings; and are kept in the quarters of the keepers, in frames, so that no one can ever be at a loss to know his duty. The different kinds of lamps employed are described, and the modes of attending to them pointed out, in plain, clear, and explicit terms, adapted especially to the understandings of the keepers of the lights. The subjects contained in the printed instructions and manuals would form a part of the essentials in the examinations for qualifications of keepers.

BEST MODE OF SECURING ATTENTION TO INSTRUCTIONS.

The system of inspection already recommended, the examinations for higher positions in the districts, and the exercise of the present power of removal for neglect or disobedience of instructions, would secure a due degree of attention to them. If promotions were made entirely by merit, on the recommendation of the general or local inspectors, and
changes, not depending upon want of qualification, were avoided, there would be, doubtless, great improvement in the knowledge, skill, and attention of the light-keepers.

MATERIALS FOR THE CONSTRUCTION OF LIGHT-HOUSES.

Very full details will be found on this subject in the report already referred to, including the subjects of mortars and cements, of plans for foundations and superstructures, &c.

IMPROVEMENTS IN THE MATERIALS FOR ILLUMINATION.

In regard to the substitution of the oil of colza, (rape-seed,) now used exclusively for light-house purposes in France, England, Scotland, and Ireland, and in most of the light-houses of the other maritime nations, for spermaceti oil, or, more properly, for that used in our lights, the board would refer to the fact, that the recommendation of the select committee of the House of Commons of Great Britain, in 1845, to the light-house board, to introduce the more economical oil of colza into their light-house establishments, had the effect of causing a thorough experimental examination to be made of the two oils, (colza and the best winter-strained sperm oil,) by Professor Faraday, Mr. Alan Stevenson, and others interested in light-house service, by which it was clearly demonstrated that the colza oil is superior, in every essential particular, to the best winter-strained sperm oil.

Professor Faraday says, in his report:

"Having burnt the lamps for many days, I have been much struck by the great steadiness of the rape-oil lamps, either as considered alone or in comparison with the sperm-oil lamps. They would burn for twelve or fourteen hours at a time with little or no alteration of the light, the cottons or lamps not being touched the whole time; whereas the sperm-oil lamps would, in the course of four, five, or six hours, give a diminished flame, from the incrustation of the charred part of the cotton retarding the flow of oil. In the rape-oil lamps the coal is broken and porous, and serves for wick almost as well as the fresh cotton; but in the sperm-oil lamps the coal forms a hard, continuous ring, which seals up the ends of the threads; and this, with the more confined condition of the burner, and the greater distance of the oil beneath, (from intentional difference of flow in the lamps,) causes the sperm-oil lamp flame to fall in brightness, and requires that the wick should be retrimmed.

"I have made many careful experiments on the proportion of light produced by the two kinds of lamps, in every case weighing the oil before and after combustion, so as to know exactly the quantity burnt, and making, during the experiments, above a hundred comparisons of the lights one with another. The rape-oil lamps were always more brilliant than the sperm-oil lamps, except, indeed, in one or two rare cases; but, at the same time, more oil was burnt in them. "

"From 108 observations of the lights, taken at such times as appeared fitted to give the best mean expression of the light of the lamps com-
pared with the oil burnt in them, the average light of the rape-oil lamp came out as one and a half, that of the sperm-oil lamp being one."

Mr. Alan Stevenson says:

"In my last annual report on the state of the light-houses, I directed the attention of the board to the propriety of making trial, at several stations, of the patent colza or rape-seed oil, prepared by Messrs. Briggs, of Bishopsgate street. These trials have now been made, during the months of January and February, at three catoptric and three dioptric lights. * * * The substantial agreement of all the reports, as to the qualities of the oil, renders it needless to enter into any details as to the slightly varying circumstances of each case; and I have, therefore, great satisfaction in briefly stating, as follows, the very favorable conclusions at which I have arrived:

"1. The colza oil possesses the advantage of remaining fluid at temperatures which thicken the spermaceti oil, so that it requires the application of the frost-lamp.

* * * * * * * * *

"3. The colza oil burns, both in the Fresnel lamp and the single Argand burner, with a thick wick, during seventeen hours, without requiring any coaling of the wick or any adjustment of the damper, and the flame seems to be more steady and free from flickering than that from spermaceti oil.

"4. There seems (most probably owing to the greater steadiness of the flame) to be less breakage of glass chimneys with the colza than with the sperm oil.

"5. The consumption of oil, in so far as that can be ascertained during so short a period of trial, seems, in the Fresnel lamp, to be 121 for colza and 114 for spermaceti; while in the common Argand lamp, the consumption appears to be 910 for colza and 902 for spermaceti.

"6. If we may assume the means of these numbers, 515, for colza and 508 for spermaceti, as representing the relative expenditure of these oils, and if the price of the colza is 3s. 9d., while that of spermaceti is 6s. 9d. per imperial gallon, we shall have a saving in the ratio of 1 to 1.775, which, at the present rate of supply for the Northern lights, would give a saving of about £3,266 per annum."

The evidence of these two distinguished gentlemen is conclusive of the superiority of the colza or rape-seed oil to the best winter-strained sperm oil; and how much better than that used in our lights, may be readily inferred without the aid of experiments on so nice a scale as those employed by Prof. Faraday and Mr. Stevenson, when it is remembered that our lights are supplied with oil called winter and spring or summer oil.

That efficient lights along the coasts of all maritime countries are essential to a safe navigation, and the successful prosecution of a lucrative commerce, will not be contested; that all mere personal or local interests should give way to the general good, is an assumption which will not meet with disfavor in this country; and inasmuch as it is of paramount importance to the best interests of the whole country, that our lights and other aids to navigation should be the best which money, science, and the mechanic arts will afford, it is, in the opinion of the
board, the duty of those charged with this important branch of the public service to employ every reasonable means, not inconsistent with law, to perfect them, and therefore recommend that the subject of introducing other combustibles than the oil now used be taken into serious consideration, as one of the means of improving our lights, and, at the same time, of effecting considerable annual saving of expense to the country.

If the rape-seed were cultivated to any extent in this country, it is not doubted it would supply the place of the numerous chemical oils, fluids, &c., now in general use for domestic purposes, as well as for lighting our light-houses and light-vessels. To insure the consummation of so desirable an object as the cultivation of this plant on a large scale in this country, where climate and soil are so well adapted to it, will be to place it in a fair competition with its rivals.

It will be the duty of the board, if authorized by Congress, among its numerous other important duties connected with the light-house establishment, to examine into the merits of all proposed improvements in apparatus and combustibles, and, by their recommendations to Congress, keep pace with the improvements of other countries in this branch.

The introduction of gas into light-houses has long been looked forward to as an important step. Hitherto it has met with but little favor in any quarter. While the introduction of gas into our light-houses, if found adaptable to them, would involve important points to be considered, it is by no means certain that by the means of a series of experiments, the board would not be enabled to decide conclusively as to the practicability of making the attempt in the present state of knowledge, or the best and safest means of generating, conducting, and continuing it for light-house purposes. The persons charged with the few gas-lights now existing in this country, for want of practical and theoretical knowledge, it is believed, are not competent to report results sufficiently reliable to decide so important a question. (Vide letter of Fifth Auditor—gas-lights.)

BUOYS.

The forms given to buoys in England, Scotland, and the United States, are shown in the annexed plates.

The material is iron or wood, sometimes covered with sheet-copper.

The anchors are heavy blocks of stone, or mushroom anchors, or iron sinkers (which should be hollowed out below,) or iron screws. It is worth trial whether fastening the buoy by a transverse line passing through the centre of oscillation would not diminish the liability to chafe off the chain, and separate the buoy from the anchor. A swivel-shackle, in a degree, prevents this, but not effectually.

The colors of buoys are made to indicate their purpose, as designating a channel, shoal, spit, &c. They are sometimes even characteristically marked to distinguish them.

The law passed in 1850, in regard to coloring and numbering buoys in the United States, is simple and effective. The numbers were intended to begin at the exterior of a bay, harbor, &c. This law is as follows:

Extract from an act making appropriation for light-houses, light-ves-
sels, buoys, &c., and providing for the creation and establishment of the same, and for other purposes, approved September 28, 1850:

"Sec. 6. And be it further enacted, That hereafter all buoys along the coast, or in the bays, harbors, sounds or channels, shall be colored and numbered, so that, passing up the coast, or sound, or entering the bay, harbor, or channel, red buoys with even numbers shall be passed on the starboard hand; black buoys with uneven numbers, on the port hand; and buoys with red and black stripes, on either hand. Buoys in channel-ways to be colored with alternate white and black perpendicular stripes."

Of course the buoys show, with more or less distinctness, when projected on the water, against the sky, trees, &c.

The red buoys should be painted a bright red, and not a Spanish brown, in order to be well distinguished—red lead or vermilion being used as the paint. The experiments and observations of the board satisfied them that in such a case, red and black were good colors for distinguishing buoys. The can buoys, in some instances, (as in New York harbor,) are too small to be easily seen.

The numbering is a simple matter, but is by no means effectively executed, especially on the spar buoys, where the numbers repeated on the different sides, being seen in a range in a diagonal view, lead to confusion.

The board have given some attention to plans for numbering buoys. The numbers should be placed above the buoys, on stems or perches; should present the same appearance on different sides, and have their distinctions by difference in a vertical line, and not by varying horizontally.

Several plans have occurred to them. Three solids, the cone, cylinder, and sphere, arranged in groups of not more than three each, will give forty-two combinations; no one of these figures can be taken for the other, and they may easily be placed on stems projecting nearly vertically above the buoy, the several solids being placed one above the other, with a sufficient interval. They can be of adequate size, and may be cheaply made in the turning lathe.

* * * * * * * * * * *

In the English system of placing buoys, a red and black are placed on opposite sides of a channel, and the vessel runs between them. In our system only one buoy is placed on the starboard or port hand, and the vessel runs for the buoy, keeping it close aboard in passing. The English system is most simple, and even the most economical. In order to render buoys available at night, various propositions have been made for causing them to appear luminous, but none have succeeded practically. Mr. Babbage proposes a gas-light, which might be produced by easily decomposable materials, or from compressed gas, which, when once lighted, would burn for a considerable time. If a pile were substituted for a buoy, it might be practicable to cause a prism, placed on it, to show by reflected or refracted light; the rise and fall of the tide keeping the prism in constant revolution, and the light being directed upon it from the shore. In many cases, a single screw-pile
may be necessary, as for mooring purposes, being substituted for a floating buoy.

The board propose at an early day to enter upon the series of experiments authorized by the Department to be made, a report upon which, and upon other matters not fully reported upon at this time, embraced in your instructions, shall also be made in time to be laid before the present session of Congress.

The board having thus endeavored to place before the Department and Congress the present condition of the light-house establishment, which has existed since 1789, without that fostering care from legislation which its great importance demands, and with the view of remedying, as far as they can be, the defects now existing in all its branches; having recommended the organization of a Light-house Board, subject to the superintendence and direction of the Secretary of the Treasury, which shall be composed of persons of ability, whose professions and vocations best adapt them to these duties; and following the example of the best light-house establishments in the world, recommend that these duties shall be performed without additional compensation.

The board are clearly of the opinion that the present light-house establishment can only be improved and rendered as efficient as the interests of the country demand, by changing its present character, in so far as to place it in the hands of such eminent professional men as they have proposed.

The board cannot close this report without acknowledging, through you, sir, their great obligations to Charles Babbage, Esq., of London, for his valuable communication to them, through one of their members, disclosing his plan of distinguishing lights by occultations, &c., (vide Appendix;) to M. Léonor Fresnel, officier de la légion d'honneur, inspecteur divisionnaire des ponts et chaussées, &c., Paris; M. L. Reynaud, ingénieur en chef des ponts et chaussées, secrétaire de la Commission des Phares, &c., Paris; Mr. Jacob Herbert, secretary to the Trinity House board, London; Mr. William Lord, marine surveyor to the port of Liverpool, &c.; Mr. Stevenson, civil engineer, Edinburgh; M. Henry Lepaute, of Paris, constructor of lenses; M. Theodore Letourneau, constructor of lenses, Paris; and Mr. Alexander Mitchell, of Belfast, Ireland—for their valuable communications, accompanying documents, and drawings; and also to the numerous individuals in this country interested in commerce and navigation, who have kindly furnished replies to their letters asking for information upon the subject of light-house comparisons or improvements. (Vide letters, &c., Appendix.)

The board are under additional obligations to M. Reynaud, the distinguished engineer, secretary to the Commission des Phares, of France, for numerous beautiful specimens of glass chimneys and wicks for light-house lamps and for drawings of value connected with the service.

The board would further avail themselves of this occasion to tender their thanks to the Hon. William C. Rives, envoy extraordinary and minister pleni potentiary to France, and to Hon. Abbott Lawrence, envoy extraordinary and minister pleni potentiary to the court of St. James,
for their kindness in becoming the medium of communication between the board and the light-house authorities of those countries.
All of which is respectfully submitted.

W. BRANFORD SHUBRICK,
President.

JOS. G. TOTTEN,
Brevet Brigadier General.

JAMES KEARNEY,
Lieutenant Colonel Topographical Engineers.

F. S. DUPONT,
Commander U. S. Navy.

A. D. BACHE.
THORNTON A. JENKINS,
Lieutenant U. S. Navy, Secretary to Light-house Board.

To Hon. Thomas Corwin,
Secretary of the Treasury.

Office of Light-house Board,
January 6, 1852.

Sir: By direction of the Light-house Board, I have the honor to communicate certain resolutions adopted by it in relation to illumination of light-houses.

These resolutions were adopted unanimously, and are the result of information gathered from various sources and embodied in a report now in preparation, and which will very shortly be submitted; they are submitted in advance of the report, that the Department may be at the earliest moment in possession of the views of the board on the subject of the seventh and ninth sections of the act of Congress of March 3, 1851.

I am, very respectfully, your obedient servant,

WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury.

At a full meeting of the Light-house Board, holden on the 6th of January, 1852, the following resolutions were offered and unanimously adopted:
Resolved, That it is the opinion of this board—
1. That the lens or Fresnel system of light-house illumination is the best at present known.
2. That the lens or Fresnel system of light-house illumination is, in economy, brilliancy, power, and usefulness, superior to the best reflector system of illumination in the ratio of about 4 to 1; or, in other words,
that the lens system is about four times more advantageous than the best reflector system, and at the same time at an expense, for oil alone, of only one-fourth as much as the reflector system.

3. That the lens system of light-house illumination is as well adapted to the coasts of the United States as to those of the rest of the maritime world.

4. That while there is no well-founded objection to introducing the lens system of illumination into this country, there is every reason for doing so as rapidly as possible.

5. That the floating lights of this country are comparatively useless to the mariner, in consequence of the very inferior apparatus employed in them.

6. That the reflector lights of the United States are greatly inferior in usefulness, power, and range, to the same description of lights in foreign countries generally, but especially to those of Great Britain.

Resolved, therefore, That this board, in obedience to the instructions of the Treasury Department, respectfully recommend to the Hon. Secretary to direct the introduction of Fresnel lens apparatus into all new lights that are now or that may be hereafter authorized to be erected, and also into all lights requiring new illuminating apparatus, in conformity to the seventh section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851.

Resolved, That this board further respectfully recommend that the Hon. Secretary of the Treasury direct that all floating lights now authorized and all that may be hereafter authorized, and also all requiring new illuminating apparatus, may be fitted with the best system of reflectors and lamps, or Fresnel lenses, and that the best reflectors which may be taken from light-houses requiring new apparatus shall be placed in floating lights, with reference to the importance of the light and condition of the reflectors and lamps.

Resolved, That this board respectfully recommend that all works relating to new structures, alterations of buildings, and all extensive repairs of towers and buildings belonging to the light-house establishment, be placed under the charge of an engineer of the Army, upon whose plans and estimates, when approved by the proper authority, the contracts shall be made, and under whose superintendence the work shall be executed, in conformity to the ninth section of the act making appropriations for light-houses, light-boats, buoys, &c., approved March 3, 1851.

Resolved, That the president of the board address a letter to the Hon. Secretary of the Treasury, communicating the foregoing resolutions.

WM. B. SHUBRICK,
President Light-house Board.

A true copy:
THORNTON A. JENKINS,
Secretary to Light-house Board.
PLAN FOR DISTINGUISHING SEA-COAST AND OTHER LIGHTS BY OCCULTATIONS.

BY CHARLES BABBAGE, ESQ., &C., LONDON.

Resolution of thanks to Charles Babbage, Esq.

Resolved. That the Light-house Board of the United States have received with much gratification, and have examined with great interest, the plan of distinguishing sea-coast and other lights by occultations, proposed by Charles Babbage, Esq., of London, and kindly communicated to them, and will use every endeavor to have a full trial made of the method, which in their opinion promises such great advantages to the navigation of the world.

Resolved, That the thanks of the board are hereby tendered to Charles Babbage, Esq., for his communication made on the invitation of one of its members.

Adopted unanimously, November 26, 1851.

WM. BRANFORD SHUBRICK, President.

THORNTON A. JENKINS, Secretary.

NOTES RESPECTING LIGHT-HOUSES.

BY CHARLES BABBAGE, ESQ.

The object of these notes is to point out certain improvements in the use of existing light-houses, by which it shall become almost impossible—

1st, to mistake any casual light, on shore or at sea, for a light-house; 2d, ever to mistake one light-house for another.

The plan requires, in most instances, no change in the optical means at present used for condensing and directing the illumination of light-houses; it adds slightly to the facility of observing them at great distances, and from its simplicity and generality is equally adapted to the use of all countries. Revolving lights must become fixed; but the mechanism already existing for their rotation may, with little alteration, be employed for the motions required by the new system.

The principle by which these objects are to be accomplished, is to—

Make each light-house repeat its own number continually, during the whole time it is lighted.

This is accomplished by enclosing the upper part of the glass cylinder of the Argand burner by a thin tube of tin or brass, which, when made to descend slowly before the flame, and then allowed suddenly to start back, will cause an occultation and reappearance of the light.

The number belonging to a light-house may be thus indicated to distant vessels. Take as an example 243.

1. Let there be two occultations.
3. Three occultations.
5. Four occultations.
6. A longer interval of time.
This system of occultations must be repeated all night by proper mechanism.

The rapidity of the occultations themselves, the length of the pauses between the units and the tens, and between the tens and the hundreds, as well as the duration of the long interval of time which marks the termination of the number, must be made the subject of experiment.

A light has been already used as an illustration, in which the occultations occurred at intervals of one second; the pause occupied four, and the long interval ten seconds. The pause was thought to be unnecessarily long, and was diminished. Whatever may be the times ultimately adopted, the experiments already made render it improbable that the average time required by a light-house for repeating its number should amount to one minute.

It is by no means necessary that the counting of the number of a light-house should commence with the digit which expresses hundreds. No greater amount of time would have elapsed, if, in the above instance, the observer had commenced with counting the unit's figure. It would then have read thus:

(3 occultations,) long interval, (2 occultations,) pause, (4 occultations,) pause.

But, since the long interval denotes the commencement of a number it is already apparent that the number of the light-house is 243, and not 324.

In order still further to prevent mistakes arising from an accidental error in counting the number of occultations, it will be convenient to establish another principle for the purpose of numbering the light-houses.

Light-houses must not be numbered in the order of their position. But every light-house must have such a number assigned to it, that no digit occurring in the number denoting the several light-houses nearest to it on either side shall have the same digit in the same place of figures.

If five adjacent light-houses were thus numbered: 361, 517, 243, 876, and 182, supposing a mistake to have occurred in the first time of counting 243, and that it had been reported to the master of the vessel as 253, he would immediately, on looking at his numerical list of light-houses, perceive that a mistake had been made in the middle figure, because in any general arrangement the number 253 would have been assigned to some light-house on a coast very distant from that on which 243 was placed. In fact, two out of any three figures would always detect the error of the third.

The law of numbering just stated is sufficient for the present object. Probably a little inquiry might produce a still better arrangement.

Thus occultations would distinguish every light-house from all casual lights, and their number would identify the light itself. The whole illuminating power would be always employed, undiminished by the interposition of colored glass. These lights would be more easily visible at a distance, because it is known that the eye perceives more readily a faint light which is intermittent than an equal light which is continuous.
OF HARBOR LIGHTS.

The same principle of numerical lights is equally applicable to light-houses which indicate harbors. Information, however, of another kind, is often requisite for vessels about to enter them. It is always desirable that the depth of water, either within the harbor or on the bar, should be known.

This may be effected most simply by allowing the occultations of white light to indicate the number of the light-house, and instead of having a long interval of white light between each repetition, let a colored glass be placed before the light, and a number of occultations be made, equal to the number of feet of water existing at the time.

Thus a tidal harbor light-house will continually repeat its own proper number in white light, followed by the number of feet of water on the bar in colored light. If it should be thought desirable, it would be easy to make the color of the light blue when the tide is rising, and green when it is falling.

The mechanism for harbor lights need not be complicated, and by means of a float might be made entirely self-acting. The weight necessary for making the occultations might even be wound up by the float itself.

Another great advantage of a float is, that the depth of water indicated will always be the real depth at the time. The computed depth often differs from the true depth, owing to the influence of storms, and other accidental causes.

Some additions to this mechanism would enable it to indicate the depth of water on the bar by day as well as by night.

OF FOG-SIGNALS.

During the prevalence of fogs, the lights which ought to guide the seaman are often indistinctly seen, or entirely obscured, until he has approached too near the danger against which they were intended to warn him.

In cases of fog, light-ships and light-houses are in some instances provided with gongs and bells, which are then kept constantly sounding. It is unfortunate that the means of warning the seaman of his danger should extend to the shortest distance when that danger is most imminent. The lights usually employed are visible at a distance of from six to thirty miles; but the sound of a gong or bell is heard at a comparatively very small distance.

When these instruments are heard they merely indicate danger, but not its exact nature. It might in some cases be of great importance that the gong or bell should indicate the number of the light-ship. This could be accomplished by a very trifling alteration in the mechanism. Instead of striking the instrument at fixed intervals, let there be pauses and a long interval between the number of strokes which successively represent the digits of the number of the light-ship, just in the same manner as has been proposed for light-houses.

A light-house or light-ship whose number is 243, would be thus indicated during fogs:
(2 blows on gong,) pause, (4 blows on gong,) pause, (3 blows on gong,) long interval.

The same mechanism which caused the occultations of the light might produce the blows on the gong.

The preceding explanations are sufficient to show that each light-house or light-ship, by continually repeating its own number, might render any mistake of it for a different light very nearly impossible. The great principle on which the system rests is to give numerical expression to each light. If it be not thought necessary to apply it to every light-house, the most important may be chosen for its application. The expense of the alteration, and the amount of danger incurred by a mistake, will furnish the ground of decision in each individual case.

In proposing, however, a new system which has extensive bearings on other questions connected with the safety of those who travel on the waters, it is desirable that a general and comprehensive view should be taken of such of its applications as the rapid advance in mechanical and chemical science justify us in supposing must take place in a few years.

However partially the system may be adopted at first, a judicious foresight into its probable applications may enable us, without any present inconvenience, to accelerate future improvements, and to save considerable expense on their adoption.

The following suggestions for improvements or applications, many of which are perfectly practicable at the present time, are offered for the consideration of those who may be called upon to carry out the Numerical System of Light-houses. They are not necessary for the success of the simple plan which has been already described, but may be adopted or rejected without any interference with it.

**Suggestions for the Improvement of Light-House Signals, Buys, &c.**

*Telegraphic communication during the night between light-houses and ships in distress.*

Cases occur in which it is of great consequence that a ship should communicate with the land long before it can send a boat ashore, or enter its intended port. It may be the bearer of important intelligence. It may convey some personage whose presence is essential for some great object. The vessel itself may be in distress. The state of the elements may render it impossible to send for, or receive any assistance from the land; yet, even under such unfavorable circumstances, if directions from skilful pilots acquainted with the coast could be conveyed to the ship, its wreck might, perhaps, be prevented; or, if driven on shore, having been directed to the least unfavorable spot, its crew might possibly be saved.

Such communications might easily be organized. There are already existing in the Royal Navy in the East India Company's service, and elsewhere, large dictionaries of numerical signals. These, it is true, are made by flags or by balls; but the same numbers may be expressed
by the occultations of lamps. Any number, however large, may be expressed by making the number of occultations corresponding to the first or highest digit, then allowing a pause; after which the number of occultations representing the second digit, then a pause; and so on, always observing that, after the unit's figure has been expressed, there must follow a long interval.

The plan for telegraphic communication would be thus arranged:
1. Light-house repeating its own number.
2. Ship fires a gun, and hoists a light, to call the attention of the light-keeper.
3. Light-house ceases repeating its number, and becomes a steady light, thus informing the ship that it is observed.
4. Ship having prepared its message, numerically expresses it by the occultations of its own lamp.
5. Light-house repeats the message of ship, in order to show that it has been rightly understood.
6. Light-house now repeats its own number, whilst it is preparing the answer.
7. Light-house expresses its answer by occultations.
8. Ship repeats the answer.

This interchange of question and answer is continued as long as necessary, during which the light-house repeats its own number previously to each reply.

Very little delay will occur: for these questions and answers will be arranged on movable disks, which may be placed in the mechanism employed for occulting, even while it is repeating another message. Many such disks, each containing a different message, may be placed in the machine at once, and on touching any lever the light will continue repeating the corresponding message.

In case of a ship in distress, for instance, requiring an anchor of given weight, it may be necessary to send to the harbor master of the adjacent port to give the order, and to ascertain the time when it can reach the vessel. During this interval, the light-house will be repeating its own number.

An electric telegraph from the light-house to the dwelling of the harbor master, would save much time, and in some cases much damage.

The gun fired by the vessel might also be heard by the harbor master, and his attention then being directed to the telegraph light-house, the whole time might be saved. If even his own house was invisible to the ship, but within view of the light-house, he might by means of a small light correspond with the ship through the intervention of the light-house, repeating the signals of both parties.

Colored shades might, if thought expedient, be used for different dictionaries; or an entirely independent lanthorn might be specially devoted to signals; but this would cause additional expense, and seems unnecessary.

It may be objected to this plan, that it would mislead other vessels on first coming in sight of the light-house. This objection, however, will be found on examination to be invalid; for a ship on first getting sight of a light-house, will be at the distance of many miles; and as all
telegraphic messages would consist of more than three places of figures, the ship would immediately perceive that the light-house was acting telegraphically, and, on turning to the dictionary, would even become acquainted with its message. Besides, in the course of every three minutes, at least, the light-house would repeat its own number. Thus the ship would always know that it was in the presence of a light-house; and if its reckoning did not enable it to identify the light, it could only remain in doubt during a few minutes.

*Telegraphic signals between ships at night.*

The application of the system of occultations to ships at sea, may not, perhaps, be quite so easy as that which is proposed for light-houses, but no objections have yet occurred which appear at all insurmountable.

The question of the position of the occulted light or lights placed on the ship, must be settled by practical men after due consideration and experiment. It may, however, be suggested that a light hid by a mast or sail may yet have its occultations made perfectly apparent by reflection from another sail. If such a system of signals were adopted, fleets might sail in company during the night, each repeating its own number, and any orders could be conveyed to any individual ship.

Specific lights have already been employed to distinguish sailing vessels from steamers, in order to prevent collision. By adapting the system of occultations to one or more of the lights of steamers, their character would appear more distinctly, and at greater distances. Perhaps, indeed, it would be better to have the distinctive character of a steam-vessel, indicated by a continual enlargement and diminution of its light, rather than by an occultation. Two steamers also would have much less reason for approaching each other, because they could hold any correspondence by signals. They might also by the same means convey to each other their intended course long before they approach each other.

*Of a universal dictionary of signals.*

Whether the system of occultations be generally adopted or not, numerical dictionaries of signals have been found absolutely necessary, and have long been in use. The rapid increase, both of ships and of steamers render some common language for all nations almost a matter of necessity.

The concurrence between the adjacent nations, in numbering their respective light-houses, would be essential if any numerical system is adopted for distinguishing them. Such an opportunity ought not to be lost of rendering those discussions still more useful by attempting to organize a plan for a universal system of numerical signals. The first step might, perhaps, be that each nation should supply all questions and answers that ships could ever require for their safety or convenience. Out of these, the duplicates being omitted, the first draft of the naval part of the dictionary might be formed. This being submitted to criticism, would probably itself suggest many additions.

The questions should be very carefully translated into the languages
of all maritime nations, and should be printed in columns for each language.

A dictionary of this kind, containing about five thousand terms in ten European languages, was published in 1849, by M. K. P. Ter Reehorst. The words are contained on about two hundred double pages; and since each word, of which there are usually about twenty-five in a page, is numbered, this work might be used as a numerical telegraphic dictionary.

If a more general dictionary were undertaken, other considerations arise, and the great questions relating to the philosophy of language must be examined with reference to such a work. It will, however, be sufficiently early to enter on that subject when any steps are seriously taken to accomplish so desirable an object.

The continually increasing use of the electric telegraph renders a universal language still more desirable.

Of the identification of a light-house.

A case has been more than once suggested to the author, to which it may be desirable to advert, in order to point out the course of experiment which may lead to its removal.

At certain periods of the year, and on certain coasts, there occur dense fogs. Under these circumstances, it has happened that a vessel has, on a partial and momentary opening in the fog, insufficient to show more than a single occultation, found herself almost close upon a light-house. In such a case, there is neither time nor opportunity to ascertain its number.

It may here be remarked, that the assumed danger of going ashore is so imminent that it is not necessary to know the number. It is sufficient for the moment to know that there is a light-house in a certain direction, which is close at hand.

It must, however, be admitted that, in common with all received systems of lights, the method of occultations will not furnish a remedy. If a colored light is already employed in particular localities, to meet such a case, it will still accomplish the purpose when occultations are applied to it.

The danger, although rare, ought, however, to be provided against. The following remarks are suggested to assist in attaining that object:

The time between two occultations (usually one second) might be doubled in special cases. A little experience would enable most men to recognize the fact after two occultations. If such light-houses were placed alternately with others, no light-house would be mistaken for either of its adjacent neighbors. This plan might be partially extended, but it is liable to objections.

Another view may be taken. Is it possible to give a specific character to the occultation itself? It has been found, that if the occulting cylinder descend rather slowly over the lamp, and then, after a very short pause, rise suddenly, the effect is best. It has also been observed, when an accidental defect in the apparatus caused the cylinder, after suddenly rising up, to rebound, and again to obscure partially the lamp, that the nature of the occultation was peculiarly characteristic. This
peculiarity was very remarkable up to a certain distance, after which it became lost. Almost any form of peculiarity can be given to the occultations by giving proper forms to the cams which govern them. The fact that such peculiarities are not seen until the ship has approached within certain distances, does not appear to present a material difficulty, and may even prove an advantage.

It would seem, then, to be desirable to institute a series of experiments to determine the following questions: Can the occultations of a lamp, in which the rapid reappearance of the light occurs from the falling down of the shade, be distinguished from those in which it occurs in consequence of the rapid rising up of the shade; and if so, at what distance? In some cases, the shades might move from right to left, and in the reverse direction. What peculiarities in occultations can be seen at the greatest distances?

Amongst the experiments still required, may be mentioned the loss of light resulting from the interposition of colored glasses, and also the proportion of light lost by sacrificing given portions of various parts of the optical apparatus used for concentrating it. This is necessary, in order to enable us to judge what portion may be most economically sacrificed, in case the space might be required for other purposes.

The dangers arising from fogs are of such an extent that all the resources of science ought to be called in to remove them. Voltaic light can scarcely be depended upon, except under continual superintendence; it would therefore be expensive. If, however, any intense light can be found capable of penetrating dense fogs, it might, during their continuance, be good economy to employ it even at considerable expense.

Perhaps the ordinary light-house lamps might be supplied with oxygen during fogs; its expenditure being regulated by the obscurity to be penetrated.

Possibly portions of phosphorus might be burnt in oxygen, and the light-house would then express its number by a series of flashes, and of pauses between them. The new form which that body is now known to assume might render its application to this purpose free from danger.

*On sounds used for signals.*

Both gongs and bells are employed as substitutes for lights during fogs. I am not aware of any series of experiments on the distances at which sounds of various kinds can be heard. In a question on which so much property and so many lives depend, it is surely important to be well informed. The only resource is experiment. It may be remarked that the low notes of the gong might be confounded with those of the roll of waves breaking on the shore, whilst the shrill whistle of the steam-engine will find a rival in the wind whistling through the rigging. The trumpet and the new and still more powerful instrument at the recent exposition ought also to be compared.

Again, although some of these may be heard at greater distances in the open air, some may be more easily adapted to have their sound concentrated and directed, when placed in the focus of a parabolic mirror, or, perhaps, at the end of a long tube.
Sound is transmitted to considerable distance through water, and it has been suggested that this might be used in case of fogs. But it seems probable that sound would be much interrupted in its progress from the constant motion of the waves; and if it were transmitted at a considerable depth, it might be difficult for a vessel to send down an apparatus to render it sensible.

Experiments should be made on the distance at which sounds can be heard under water in various circumstances of its motion.

If, during storms, the surface only is agitated, it might be possible to transmit sounds in the still water near the bottom to considerable distances. Thus channels might be traversed by telegraphic communications with a less costly apparatus than that of the electric wire. It ought also to be ascertained whether the forms of the instrument struck would enable them to project their sounds in particular directions. Gongs, bells, and the firing of cannon under water are among the sounds to be tried.

Whatever may be the sound audible at the greatest distance, it will be necessary to ascertain what are the best means of producing it in greatest intensity—whether by one large instrument or by many small ones. It seems probable that some combination of discordant sounds may be most effective, because it seems to be a law of our nature that contrasts produce stronger impressions than uniformity. There is one form of sound the most disagreeable with which we are acquainted; it is said "to set the teeth on edge." What is the cause of this, and does that highly obnoxious sound penetrate farther than others? If it penetrates as far as others, it will certainly be the earliest to be noticed.

Lights on buoys.

The time is probably not remote when lights will be placed on floating buoys for the purpose of pointing out isolated dangers—as sunken rocks, shoals, &c., on which light-houses cannot be placed, or where the great expense may prevent them from being built. They may also be useful to indicate the channels leading to some few ports of very great resort, in order to render the approach of vessels possible during the night.

The first difficulty in placing lights on buoys arises from the necessity of trimming the lamps and of supplying them with fresh oil. Galvanic processes seem to present a similar difficulty. The chemical discoveries of recent times, however, offer some hope of removing it. By the destructive distillation of peat, of coal, and of shale, as well as by other methods, a variety of combinations of hydrogen and carbon have been obtained. Some of these only remain liquid under a pressure of two or three atmospheres. They possess considerable illuminating power, and by confining them in a close vessel, and allowing a very small aperture for their escape in the state of gas, a jet of flame may be produced, of uniform magnitude, and without the use of a wick, until the last drop of fluid has evaporated. If such a fluid could be produced at a moderate price, a quantity might be enclosed within the buoy, sufficient to last several weeks, if not months.

Such a light would burn without the necessity of trimming, but it would
require mechanism to light it each evening and to put it out each morn-
ing.

Such mechanism already exists in many of our public clocks. If it is
thought desirable, too, that it should occult, so as to indicate its number,
the plan already described might be applied. Thus the buoy would con-
tain two pieces of mechanism. The only remaining difficulty would be
the necessity of visiting the light frequently in order to wind up the two
instruments. This might probably be removed by having within the
buoy a heavy pendulum, or perhaps two such, swinging at right angles
to each other. If the perpendicular motion of the buoy could be secured,
then the winding up pendulums must be maintained horizontally by means
of a powerful spring. These, by the action of the waves, would be con-
tinually winding up the springs which drive the mechanisms. This
might be so arranged that it would never over-wind them.

Spirits of turpentine, benzole, and several other compounds, assume a
gaseous state at very low temperatures. If the end of a tolerably thick
rod of metal is heated by the flame of the lamp, and the other end con-
ducts the heat to the bottom of the fluid, it is sufficient to produce a con-
tinuous stream of gas to supply the burner until the last drop of the
fluid is exhausted. Lamps constructed on this principle have, under
various names, been in use for several years. If the fluid were sufficiently
cheap, one of these movements might be dispensed with by allowing the
light to burn constantly during the day as well as the night.

New forms would be required for such buoys. Probably a columnar
form, weighted at the bottom, might give a steadier light amid the fluc-
tuations caused by the waves. These buoys should be attached to their
moorings by rings fixed at the centre of resistance.

Of the mechanism necessary for occulting lights.

The period of time occupied by any occulting light in making a signal
is so short that great accuracy in the wheel-work is not necessary. In
light-houses the moving power may be a heavy weight driving a train of
wheels. This must terminate in a governor, which presses by springs
against the inner side of a hollow cylinder.

When the length of the time necessary to indicate the number of the
light-house is known, the governor must be so adjusted that some one
axis shall revolve in the given time. A cam-wheel must be fixed on this
axis, having its cams and blank spaces so arranged as to lift up the tail
of a lever carrying the occulting cylinder, at the proper intervals of
time. Each tooth of the cam-wheel will cause an occultation of the lamp
by the cylinder, which is instantly drawn back by a spring.

It is obvious that an axis might be used which moves round in the
course of two, three, or more cycles. In this case, the same system of
cams would be repeated an equal number of times in the circumference
of the cam-wheel. This plan is sufficient for light-houses which are not
intended for signal stations also.

When signals are to be used, it is better to have a single cam on an
axis which revolves once in the time which elapses from the end of one
occultation to the end of the next. The effect of this cam will be, by
acting upon a forked lever, to lift up the occulting cylinder. If nothing
retains it in that position, the action of the spring on the lever will cause
it to descend, and the cylinder, acted on by gravity, will instantly follow.
But if an arm is interposed which retains the cylinder, then the forked
lever alone will be pulled back by its spring, and the occulting cylinder
will remain suspended until the next turn of the cam-wheel.

The suspending arm which was interposed must itself be governed by
a cam-wheel, expressing the number of the light-house.

When a signal is to be made, an adjustable cam-wheel is to be set to
the proposed signal, and is to be fixed upon the axis carrying the con-
stant number of the light-house. When the proper time arrives for
making the signal, it is only necessary to shift the axis, so that the ad-
justable cam-wheel shall be moved into the place occupied by the fixed
cam-wheel. The signal will now be made and repeated as often as
required, after which the original position of the constant cam-wheel
must be restored. It is clear that any number of adjusting cam-wheels
might be prepared for signals, and put upon the axis at once, so that a
series of different signals might be made in a very short time.

Lights to mark the depth of water must have a heavy float connected
with them, which at every foot of its rise or fall, must alter the number
of occultations made by the colored light. It is sufficient for the
present purpose to observe that the mechanism similar to that by which
a clock strikes different hours might be employed for this purpose.

The well in which the float is placed ought to be open to the tide by
several small apertures; this would render the rise or fall of the float
more uniform.

Telescopes are used for observing light-houses. They have a small
magnifying power, but a large aperture. It is important that they
should be as short as possible, for taking in a given visual angle. Pos-
sibly, those constructed with a lense of rock-crystal might be employed
with advantage, but upon this subject, also, experiment must be made.

Circular addressed to commanders of mail steamers, packet ships, &c.

OFFICE LIGHT-HOUSE BOARD,
Washington City, May 29, 1851.

SIR: I am directed by the Light-house Board, convened in this city
by order of the Hon. Secretary of the Treasury, in conformity to a late
act of Congress, to inquire into the condition of the light-house estab-
lishment of the United States, and to make a detailed report and pro-
gramme to guide legislation in extending and improving our present
system of construction, illumination, inspection, and superintendence,
to solicit from you any information which you may possess upon the
subject of light-house improvements, and as to the present condition of
lights and other aids to navigation in the United States.

The board is desirous of availing itself of information from all reli-
able sources upon this highly interesting and most important subject to
the maritime world; and as your position and opportunities afford you ample means by which to form correct opinions as to the comparative superiority or inferiority of such lights of this and of other countries which you may have had occasion to observe carefully, it relies confidently upon you to furnish, at your earliest convenience, such a statement of facts and opinions as your experience may dictate.

With the view to place the subject in its most tangible form, the following queries are submitted, to which answers are respectfully requested, in addition to any information and opinions of a general character which you may be pleased to communicate:

1. How many passages do you make on an average per annum, and between what ports?
2. What lights do you run for in those passages?
3. What the location and character of the foreign lights—the description of apparatus employed in them, their comparative brilliancy, range, steadiness, and certainty of being lighted during the entire period of time from sunsetting to sunrising—to those of the United States in positions of equal or greater importance to over-sea voyagers?
4. What the general character of the lights of this country compared to those of Great Britain, France, and the West Indies, with reference to usefulness, range, and brilliancy?
5. What the best sea-coast lights of this country, and how do they compare with the best lights of other countries (please name them) which you have seen, with reference to range and brilliancy?
6. How do the lights on the coast of the United States compare with those of Europe, &c., in their characteristic distinctions?
7. How do the light-vessels on the coast of the United States compare with those of Great Britain as to usefulness, certainty of position, brilliancy, and range of light?
8. How does the system of buoys, beacons, and sea-marks of the United States compare with that of Great Britain?

The board will be pleased to receive any information relating to particular localities or portions of the coast, with reference to additional aids to navigation, to modes of distinguishing lights in special localities, &c.

I am, very respectfully, your obedient servant,

THORNTON A. JENKINS,
Lieutenant U. S. Navy, and Secretary to Light-house Board.

Letter from Lieut. David D. Porter, United States Navy, commanding United States mail-steamer Georgia.

JULY, 1851.

Sir: I have received your communication of May 29, with enclosed act of Congress relating to light-houses, and hasten to lay before the board such information as I possess on the subject. I also do it with great pleasure, as our light-houses as at present arranged are so wretched that any seafaring man must desire a change; and I am confident that
the intelligent gentlemen composing the board will have great satisfac-
tion, at the close of their labors, in feeling that they have conferred the
greatest benefit on commerce by making a complete revolution in the
present disorganized system of light-houses.

There is at the present moment two million eight hundred thousand
dollars invested in steamships alone, which pass Cape Hatteras light
twice a month, all of which vessels run for the light and pass Hatteras
shoals close aboard. This amount of property is invested in twelve
steamships of the first class—four Charleston and Savannah ships, four
New Orleans ships, and four for Chagres; eight of these vessels take
the inshore route, passing all the lights as far as Charleston or Savannah,
and thence proceeding to New Orleans, keeping the coast on board as
far as Carysfort reef and Tortugas. I will proceed to give you an ac-
count of the lights, commencing at Sandy Hook, and follow them down
to Cape Florida, the last light we see on our route. As the Sandy
Hook light and beacons are intended principally as a guide up the bay,
I consider them as well kept, and I have always seen them showing a
clear bright light; I think they compare favorably with any harbor
lights that I have seen in foreign countries.

The Navesink fixed and revolving lights I consider the only perfect
lights on our coast, not only as regards regularity in lighting, but in the
brilliance of the light. The revolving light can be seen at a distance of
twenty-five miles in ordinary weather, and about thirty in clear winter
weather, from the top of our wheel-house, which is thirty-two feet above
the level of the sea. The revolving light is seen by us, when running
at the rate of thirteen miles an hour, about twenty minutes before the
fixed light; whether this is to be accounted for by the greater intensity
of the former, or some peculiar property of a revolving light, I don't
know, but I am disposed to think that a revolving light can be seen
much farther than a fixed light, both lights being equal. The Navesink
light compares favorably with the revolving light at Havana, which is
not so elevated as Navesink, but can be seen twenty-five miles from our
wheel-houses, and also the English light on Gunkey, which can be seen
twenty miles. These two are the best lights that I am acquainted with,
and the mariner can steer for them with perfect confidence, knowing
that they will always be lighted in time, and even in thick weather will
warn him of his danger.

The first in order on our coast is Barnegat light, much improved of
late years by the substitution of the large reflectors in place of the small
ones formerly in use; yet it is a dull light, and when the weather is at
all hazy, (as in Indian summer,) the light cannot be discerned, or if seen,
it is impossible to tell whether it is a ship's light or a light-house. I
have often been deceived in this respect, and am of the opinion that a
flashing light would be a great improvement on the present plan. The
Barnegat light can be seen about ten miles off shore in clear whether,
and, as far as I know, is regularly lighted.

The next is Little Egg Harbor light, a dim insignificant affair, with a
light sufficient to entice vessels to run for it, and in thick weather decoy
them on the shoals, which run out three miles. I have passed it often
within ten miles and have never seen it; and when seen, it could only

47 L H P
be distinguished from a ship's light by its steadiness. An intense fixed light at Egg Harbor, and a flashing light at Barnegat, would be a great assistance to vessels, and would save many from shipwreck. The distance between them is only eighteen miles, and if properly lighted they should both be seen at once coming from the south. I know nothing of the lights on Capes Henlopen, May, and Henry, and will proceed to speak of Hatteras light, the most important on our coast, and, without doubt, the worst light in the world. Cape Hatteras is the point made by all vessels going to the south, and also coming from that direction; the current of the Gulf Stream runs so close to the outer point of the shoals that vessels double as close round the breakers as possible, to avoid its influence. The only guide they have is the light, to tell them when up with the shoals; but I have always had so little confidence in it that I have been guided by the lead, without the use of which, in fact, no vessel should pass Hatteras. The first nine trips I made I never saw Hatteras light at all, though frequently passing in sight of the breakers; and when I did see it, I could not tell it from a steamer's light, excepting that the steamer's lights are much brighter. It has improved much latterly, but is still a wretched light. It is all important that Hatteras should be provided with a revolving light of great intensity, and the light to be raised fifteen feet higher than at present.

Twenty-four steamships' lights of great brilliancy pass this point in one month—nearly at the rate of one every night, (they all pass at night,) and it can be seen how easily a vessel may be deceived by taking a steamer's light for a light on shore.

There is very much required off the point of Hatteras shoal a fog-bell that can be heard at some distance. I have no doubt that a buoy could be so fixed, that it would stand the heaviest gales. It would be a great guide to vessels in foggy weather, which continues, more or less, throughout the year. There are fog-bells located in the English channel, where they are quite as much exposed as one would be at Hatteras.

Cape Lookout light, elevated a hundred feet above the level of the sea, is a most important one. Blunt's Coast Pilot says that it can be seen sixteen or eighteen miles; which is not the case, as I always pass it at night, ten and a half miles off, (shaving the outer shoal,) and it is only in very clear weather that it can be discerned. Towards morning, particularly, it is difficult to be seen, owing, it is thought, to the mist which hangs over the land; but I rather attribute it to neglect on the part of the keeper, in not rubbing off the reflectors during the night. Cape Lookout shoal runs off S. by E. ½ E. ten miles, and a vessel will only clear the end of it in seven fathoms water. I have found myself two or three times inside the shoal, looking for the light, and have been obliged to haul out without seeing it. The Double-Headed Shot Key light, (English,) though almost always surrounded by mist, can be seen at most times at a distance of eighteen miles. It is furnished with the French lens, which gives a much more intense light than the ordinary reflector; and, though a light of almost the same order as that on Cape Lookout, can be seen much farther. The rays of light seem to pierce through the mist, which is not the case with Lookout.

Cape Fear, a hundred and ten feet above the level of the sea, I have
never seen, though I pass two miles outside of Frying-Pan shoal. This shoal extends sixteen and a half miles, according to the charts, in a S. SE. direction; but by good and frequent observations I find that it extends nearly three miles farther out than it is represented; consequently, it would require a light to be seen twenty miles to be of any service. Vessels running close along the shore always make New Inlet light, which is seven miles to the northward and eastward of Cape Fear light-house; and the latter can be of little use in enabling vessels to run around the shoal. I am of opinion that a flashing light of great intensity would (if raised twelve feet higher) be seen plainly outside of the shoal. At present, the lead is the only safe guide. A fog buoy, with a heavy bell, should also be placed on the bight of Frying-Pan shoal, which forms a half-moon. It would be protected from southerly, east, and southwest winds by the shoal, and from northerly winds by the land; without doubt it would stay there forever, if properly looked after.

Cape Romain shoal extends six and a half miles south, (the extreme end,) and the light is a very good one. Towards morning it grows dim, either owing to the mists, or for want of attention to trimming—likely the latter. At ten miles it shows very fair, though it might be improved, and is not so good a light as the one on the Double-Headed Shot Key, (English.) It is intended to be distinguished by red and bright lights, but I should never distinguish the difference of the lights.

Charleston light is a very good one, (revolving,) and shows from aloft at a distance of eighteen miles, which is sufficient for all purposes of navigation. It is kept in good order, but is extinguished sometimes before daylight. The beacon is a poor one, and, if it is at all hazy, cannot be seen. Vessels have great difficulty in getting into Charleston, owing to the fogs. I have frequently been obliged to feel my way in with the lead, which cannot always be depended upon, unless a person is very familiar with the soundings; and these are so much alike off the bar, and to the southward and westward, that a vessel might easily run by, and bring up on the shoals of South Edisto. We generally are guided in by the steam whistle of a mail steamer anchored off the bar, which we can hear at the distance of six miles. This has suggested to me the idea of having a small locomotive boiler at the light-house, with a noisy whistle attached to it, and then no vessel could possibly mistake the port of Charleston. The fogs exist at this point nearly all the year round, and during the Indian summer the land can scarcely be distinguished five miles off.

To the southward and westward of Charleston is South Edisto light-boat, placed entirely too close in, (I struck on a shoal, eighteen months since, with the light-boat bearing north by west, eleven miles distant, no such shoal being marked on the chart;) and at night the light-boat cannot be seen over six miles at the best of times, which would render it useless for preventing vessels touching on the above shoal. It is only serviceable for coasting vessels and small steamers.

The light-boat on Martin's Industry (a most dangerous shoal) scarcely deserves the name; it is neither useful by day nor by night. On the contrary, vessels are induced to run, knowing there is a light-boat there,
and often get into difficulty. At night it looks very much like a farthing candle, and can be distinguished plainly only at the distance of three miles. I have passed it often at night and have never put any faith in it, preferring to run a little out of my course and be guided afterwards by the Tybee light off Savannah. In fogs it is perfectly useless, as it has no proper bell attached to it; or, if it has one, it is not used. A light-boat at this point should also be provided with a steam whistle, as all the steamers shave the shoals very close. There is no difficulty in keeping a vessel at her moorings off Martin's Industry, as the weather throughout the year is almost always mild, and the holding-ground is extremely good.

The Tybee light, though a very good one, cannot be distinguished in foggy weather, like the Charleston light; the latter flashes through the fog in a brilliant manner, while the former shows indistinctly in hazy weather, showing the superiority of revolving lights over fixed. In clear weather Tybee shows at a distance of twelve miles, which is quite sufficient, as the water is bold up to the bar, and the light and beacon show plainly before you reach the outer buoy. Tybee light should also be provided with a steam whistle, or there should be a bell buoy on the bar, which is about four miles from the light-house.

After leaving Savannah, our course is south until up with Cape Canaveral shoals. I know nothing of lights along the coast, as I never see them.

The next light we fall in with, after leaving Savannah, is Cape Canaveral; it is a good revolving light; is kept in good order, and shows eighteen miles from the masthead. Since the discovery of numerous shoals off Cape Canaveral, vessels do not run so much for the light as formerly, but go around the shoals instead of between them. The outer shoal is about twelve miles to the northward and eastward of the light-house, and at night the light shows plain enough to warn vessels that it is time to haul off shore. After clearing Cape Canaveral shoals, the current begins to take effect on the port bow of a steamer and cuts her in-shore, and it is impossible to tell how much, as it varies so much with different winds. To avoid these currents as much as possible, it is necessary to steer a S. ½ W. course, which brings a vessel up with Indian river. Here, formerly, the quartermaster of the army had a small light erected, and we found it of much service; but lately it has been removed, and the loss of it is sensibly felt. After coming up with Indian river, it becomes necessary to haul out S. SE. to avoid the shoals off Point Jupiter, in latitude 27°, nearly. I believe I was the first to discover these shoals, having touched on one in the night; and Lieutenant Rodgers, of the Coast Survey, having been notified of the fact, he has, I understand, made an examination and found others of a dangerous character. As this has now become the route for steamers, there is an absolute necessity for a light-house on Point Jupiter, in latitude 27° 15'. This is nearly the point where vessels are surrounded by shoals, the number and extent of which are not known; and when the nights are dark, and no observations of the stars can be obtained, it renders the safety of the vessel a very doubtful matter; the lead is scarcely a guide, as there are few soundings, and those not to be depended upon.
It would also be of service to vessels bound down the Gulf, to take a fresh departure from, as they often come down the stream past Carysfort reef without seeing anything. To the steamers (of which six are bound south every month) it is almost indispensable, and I only wonder that some calamity has not happened to some of them before this time.

Cape Florida light is a beacon for all persons to avoid; it is on a par with Cape Hatteras light—badly lighted and badly kept; though one of the most important on the coast. Only four months since, I saw a vessel ashore six miles to the southward of it, no doubt having been deceived by the light, which I do not think can be seen eight miles. This light should be so arranged as to be seen twenty miles, in all directions. The English light on Gunkey, right opposite to it, (a revolving light,) shows brilliantly at twenty miles. When the light on Carysfort reef is finished, and Cape Florida properly lighted, no vessel can possibly get on shore with ordinary care. I would respectfully call the attention of the board to the Gunkey light, by far the best light I ever saw. Long before the light itself shows above the horizon, the reflection and rays show very plainly. I do not know how the apparatus is arranged, but it is well worthy of imitation, like all the English lights. On the reef near Cape Largo is the floating light-ship, showing two lights, intended to be seen twelve miles, but they are scarcely discernible from the outer edge of Carysfort reef, which is from four to five miles distant. On two occasions I have passed it at night, when the lights were either very dim or not lighted; and I am informed that a brisk trade in oil is carried on with the wreckers on the reef. After Carysfort light is finished, there will no longer be a light-boat required at this point. Five vessels have gone ashore on and about Carysfort reef since I have been running this route, all of them a total loss, and no doubt all of them deceived by the light-boat, and sailing-directions, which inform the mariner that the lights can be seen twelve miles. I have no further knowledge of the lights on Florida reef, to the westward, as I leave the reef at Carysfort and steer for the Moro light, which we run for with great confidence, knowing that it is always in perfect order. I must do the Spanish authorities the justice to say that they pay great attention to the subject of light-houses, and all of their lights are of the very first order. They have lately established a light on Cape Antonio, with French lenses, and flashing, which is in no way inferior to the Moro light, and, though only ninety feet high, can be seen plainly at eighteen miles.

The lights at the mouth of the Mississippi are very fair, and can be seen plainly twelve miles. The light at Southwest Pass has settled, and has now an inclination to the northward; consequently, the rays are thrown up four or five degrees above the horizon, and it does not show so plainly as the others. There is very much needed a bell-buoy at the South Pass, which is the middle point, and which all vessels make in approaching the Mississippi. Five months in the year there is a constant fog prevailing there, and without some such guide as a fog-bell, vessels are carried by the current many miles away from the river.

The lights I have herein mentioned are the only ones I know anything about. My recollections of foreign lights (excepting those I have alluded to) are too indistinct to permit me to say anything on the subject. I
would respectfully call the attention of the board to that part of the Florida reef west of Carysfort. A large portion of our commerce passes daily along the coast, with scarcely anything to guide it; and now that our steam navigation is so rapidly increasing, and steamers have to run close, and in all weathers, I would recommend lights to be placed on the following points: On Carysfort reef, a revolving light; New Matacumbe, a fixed light; Sombrero keys, a fixed red light; and Sambres, a double light. This would give thirty-two miles between Carysfort and New Matacumbe; thirty-two miles between New Matacumbe and Sombrero keys; twenty-nine miles between Sombrero and Sambres; and sixteen miles from Sambres to Sand Key revolving light, opposite Key West. Thirty miles from Sand key, (west,) the Florida reef ends, and this point should be designated by a light-boat, with two good lights, one bright and the other red; and she could lie snugly at her moorings in northwest gales, (under the lee of Boca Grande bank,) in six fathoms water; from thence the coast is clear up to Tortugas, which is already provided with a good fixed light. The above-mentioned light-houses could light up the entire Florida reef nearly as well as Long Island sound is now lighted, and the lights would be so distinctly marked that no one could possibly mistake them. It may appear to be a large number of lights for so short a distance, but fewer would answer no purpose at all, the object being to enable a vessel to get sight of a light a short time after leaving a known one, and before the current can have taken full effect upon her. No man can know the currents of the Gulf-stream, no matter how often he may have sailed there; consequently the necessity of having in sight some constant object.

The expenditure for these lights would be small in comparison with the amount of property wrecked every year; and as the object of the lights is to benefit commerce, the expenditure ought not to be taken into consideration. No part of the coast of the United States is so badly lighted as the Florida reef. In a distance of 220 miles there are but three light-houses, while from Sapelo island to Cape Canaveral (on the coast of Georgia and Florida) there are no less than seven lights; on a coast, too, where the bottom is perfectly clear and no perceptible currents, and in a distance of 180 miles. I have nothing further to add in this communication, except to recommend that the commander of every steamship should be furnished with monthly forms, in which he shall insert the condition of each light he passes on his voyage; such report to be sent, at the termination of the voyage, to the superintendent of light-houses. This would insure watchfulness on the part of the keepers.

I am, very respectfully, your obedient servant,

DAVID D. PORTER,
Lieutenant United States Navy.

THORNTON A. JENKINS,
Lieut. U. S. Navy and Secretary to the Light-house Board.
Letter from Lieutenant H. J. Hartstene, United States Navy, commanding United States mail-steamer Illinois.

New York, July 18, 1851.

Dear Sir: In reply to your queries concerning light-houses, I am unable to give much information, as I have been running pretty much all the time between New Orleans and Chagres, via Havana; between those places I have made monthly trips, making the Moro, Cape Antonio, and SW. and S. Pass lights, at the mouths of the Mississippi. The two first named are excellent flash lights, and may be seen twenty miles; the two latter are much inferior, as also are all the lights on our coast, that I have seen, except those at the Highlands, which I presume are the best we have. The lights on Hatteras, Lookout, Canaveral, and Cape Florida, if not improved, had better be dispensed with, as the navigator is apt to run ashore looking for them.

A light is much required at the entrance of Navy bay, near Chagres; and if within your province, as I think it should be, I would recommend it to your consideration.

Yours, &c.,

H. J. HARTSTENE.

Lieut. Thornton A. Jenkins,
Secretary to Light-house Board, Washington, D. C.

——

Letter from Captain J. O Delano, commanding ship "Albert Gallatin."

New Bedford, November 25, 1851.

Sir: I found, on my return from Europe a few days since, your queries touching the comparative usefulness of the foreign and United States light-houses, to which I hasten to make a brief reply.

I do hope you will be able to show to a committee of Congress such a state of things, that that body will no longer withhold the means of improvement.

Of late years I have made six passages per annum between New York and Liverpool; previously I was in the London packets, and some years in the East India trade. The last five years I have not been at sea, except as passenger several times to and from Europe.

The lights I generally ran for were Scilly, Cape Clear, Kinsale, Waterford, Saltees, Smalls, Holyhead, &c. On the American coast, Highlands of Navesink, Fire Island, Barnegat, Long Island, and occasionally we see Block Island, Gay Head, Sankaty Head, &c.

Question as to location and character of foreign lights, comparative brilliancy and range, apparatus, steadiness, certainty, to those of the United States, in positions of equal importance?

Location of sites generally judiciously chosen by experienced and competent men, not by custom-house officers or politicians; character of houses substantial, and of the most durable materials, and much more commodious than ours. Apparatus of most of the English lights, of
the best reflecting, although many of the principal lights are on the
dioptic or Fresnel plan. I observed the remarkable brilliancy of the
lights along the coast of Holland, and on the coasts of Sweden and Nor-
way, and in the Baltic seas, and was told that they were on the Fresnel
or dioptic plan, and all agree that they are more economical than the
reflecting lights. When reflecting lights are used they are infinitely
superior to ours, being 18 to 22-inch reflectors, and, I am assured, cost-
ing £30 to £35. In brilliancy, range, and steadiness, the European
lights are certainly far ahead of ours. As to usefulness, of course in-
creased brilliancy and range give that characteristic. Most of the
European lights can be seen as far as the curvature of the earth will
allow objects to be seen. The best coast lights of the United States
are, I think, Boston, Sankaty Head, and the Highlands of Navesink.
In characteristic distinctions we are very deficient; accidents of a very
fatal nature often occur from a want of the means of distinguishing
lights. Our light-ship system much needs reform; they are announced
as being in position, but before the navigator gets there they are gone.
Duplicates should most certainly (as in other civilized parts) be in readi-
ness to be towed to the station as soon as vacated; better have none
than no relief. There is an unfortunate craft off Cutterhunk, which has
been the cause, by the periodical desertion of her post, of two or three
shipwrecks on the "Sow and Pigs." It would be a benefit to commerce
and a saving to the treasury, I think, to take her away and reserve her
as a spare light-vehicle, after building a light-house on the extreme south-
west end of Cutterhunk, with a good dioptic light of the first order. I
don't believe that it is practicable to erect one on the rocks; there is in
fact no need of it, as the rocks lie only three-fourths of a mile from the
point.

Our system of buoyage is in great need of better management. Ignor-
ant men, pilots, captains of coasters, anybody in fact, are employed by
contract to place the buoys, and they are seldom placed alike for two
successive years. An officer of the Navy, or some competent person,
should be appointed in each district, who could with a sextant place the
buoys by angles or by three known points.

It often happens that a black buoy will be found by the navigator
where the chart calls for a white one, as the person who superintends
this operation disdains a reference to the coast survey, most likely be-
cause he could not understand it. The buoys in the important port of
New York are very much out.

Navigators and ship-owners do now trust, since the appointment of a
light-house board composed of men of science and nautical experience,
that there will be a change, and that our light-houses, buoyage, and bea-
conage, will be improved so as to approach the standard of European
excellence. Our light-keepers are generally very inferior and incompe-
tent men; * * * seldom have had any instruction in their duties.
In the English and other European lights they are required to keep a
meteorological register. What a mass of interesting facts might be col-
clected along our extended coasts, if this plan were adopted. I have
heard great objection urged to the use of the dioptic light of Fresnel—
or I should say to the central lamp, with the concentric wicks—that it
is complicated, liable to get out of order; and being but one lamp, may
go out in the night. I was assured that a second was always kept at
hand, but not a single instance in the twenty-five years' experience had
occurred of a failure. The oil used is not so good as our sperm oil;
they are now trying in England the refined rape-seed oil as a substitute
for sperm, and I have it from good authority that it is equal to sperm.
I do not think it would do in our climate in the winter. I sent home a
canister of the article, which I had from Mr. Briggs, the London con-
tractor, and I find it much inferior in its burning qualities to sperm oil—
very little better than whale One more word as to location. It is
quite ridiculous what a mess the officers of the customs make in placing
lights, or misplacing them. Witness Wing's neck, Palmer's island,
Cutterhunk, where the light-house might have been so placed on the
southwest point, instead of northwest, that it would have rendered un-
necessary entirely the ''Sow and Pigs' floating light-vessel. If Palm-
er's Island light-house had been ten feet higher, it would have been a
most capital range with Clark's Point light to avoid all the ledges in
Buzzard's bay. In fact, by getting them in range, a vessel may sail in
or out in the darkest night between the ledges of that dangerous bay.

Very truly, yours,

J. C. DELANO.

Lieut. T. A. JENKINS, U. S. N.,
Secretary to Light-house Board, Washington, D. C.

Letter from Lieutenant Henry Rodgers, United States Navy, command-
ing United States mail-steamer "Falcon."

UNITED STATES MAIL STEAMSHIP FALCON,
New York, November 30, 1851.

SIR: In answer to the questions proposed in the circular of the Light-
house Board, I give herein such meagre answers as my experience affords.

I have averaged twelve voyages or twenty-four passages per annum
between New York and Chagros, via Charleston, Savannah, and Havana:
the voyages sometimes divert to New Orleans; in these voyages running
to make, and sometimes making Barnegat, Old Inlet, Roanoke, Hatteras,
Cape Lookout, Cape Fear, Cape ROMain, Charleston, Savannah, Cape
Canaveral, and Cape Florida lights, and those at the mouth of the Mis-
sissippi on our own coast, (trusting more, however, to the lead and astro-
nomical observations, than to the lights,) Double-headed Shot Key and
Gunkey, English lights on the Bahamas, and those at Havana and Cape
San Antonio, on the Island of Cuba.

The locations of foreign lights are as above named, and on low points
of land. In elevation I think they are not superior to the generality of
ours, but in brilliancy and good keeping surpass our best and most im-
portant ones, except perhaps those on the Highlands of Navesink.

I do not know how our lights compare with those on the European
coasts; but, judging from the English and Spanish colonial lights,
would suppose ours to be greatly inferior. Decidedly the best that I have
seen on our coast are those at the entrance of New York harbor, on the Highlands, resembling in appearance those at Havana and Cape San Antonio, which I have understood to be French. From New York to Brazos Santiago, our lights might undoubtedly be improved, and a better system of keeping established.

Wherever a light is placed it should be a good and reliable one, or might, perhaps, as well be dispensed with entirely, as vessels depending upon it are as likely to get into difficulty through such reliance as to be guided by it.

The coast of Florida and its reefs, particularly demand a good system, so that vessels in coasting from Cape Canaveral to Tortugas might never be out of sight of some light; and they should be so distinguished, by fixed, revolving, double and colored lights, that the navigator might readily fix his position by sight of any one of them.

I have rarely passed the Florida reefs without seeing a recent wreck or wrecks.

The English lights on the Bahamas, and the Spanish on the Island of Cuba, may be seen in good weather at a distance of twenty miles, with a good deal of certainty; and I have seen them at a considerably greater distance from aloft. Those on our coast are generally, when seen, so dim and uncertain, that it is difficult to form any correct idea of their distance.

The flashing lights at Havana and Cape San Antonio seem to me to be the best in this respect; no sooner does the light appear above the horizon than it flashes out boldly and distinctly.

False lights have been and are not unfrequently complained of on our coast, which is pretty good evidence of the inferiority of the legitimate ones.

During a large portion of the year, our sea-coast is subject to foggy and hazy weather; and at such times, signals by means of rockets, guns, whistles, or bells, might be used with benefit to commerce.

Would not the revenue lost by vessels wrecked, or obliged from injury to throw cargoes overboard, go far to cover the expense of the desirable improvements?

Additions are almost daily being made to our steam marine, and each steamer from New York to New Orleans, or any Gulf port, is for the great part of the way a coasting vessel, whatever her size.

These vessels carry immense numbers of passengers and the most valuable cargoes; and to them, competing as they must and will do for speed, and shortening distances as much as possible, good lights are almost indispensable.

It is customary for vessels navigating through the Gulf to the northward to run for the English lights on the Bahamas—for no other reason, that I can see, (as certainly the distance is increased, and the current not so favorable,) but because there is no confidence felt in the lights on the Florida coast.

From an examination of a chart of our coast, on a small scale, where each light is represented by a patch of red paint, and the intervals between them insignificant, it would, no doubt, appear to be brilliantly illuminated, but experience leads to a different and not pleasant con-
clusion. I have often, at Havana, heard captains of vessels earnestly discussing the difficulties of Gulf navigation, each one astonished that, steering some particular course, he fetched up at some point beyond all calculation out of his reckoning; owing in some cases, no doubt, to the uncertain currents, and in others to deviation of compasses.

But from whatever cause, such errors, and liabilities to error, are attended with great risk and anxiety. Good lights, and enough of them, would make plain sailing of what is now merely groping in the dark.

In running for the position of a light on our coast at night, if I make it I am thankful that the reflectors have been particularly well burnished; and if not seen, I conclude that the oil is bad, or the lamps not properly supplied, or that the light-house is washed away or blown down, so insecurely are they sometimes built.

I regret that I have been compelled to run so hurriedly over a subject of so much interest and importance, but cheerfully add this mite of experience to the mass of information which the board has doubtless collected already, believing that any changes for the better in the lights on our coast will be of immense benefit to commerce and to the country.

Very respectfully,

HENRY RODGERS, U. S. N.,
Commanding Steamer "Falcon."

Lieut. T. A. JENKINS,
Secretary to Light-house Board, Washington, D. C.

EXTRACTS FROM "NOTICES OF LIGHT-HOUSEES IN THE UNITED STATES."

BY CAPTAIN M. C. PERRY, U. S. N.

Under the present light-house system of the United States, the light-houses, light-boats, buoys, and beacons, are placed by the Treasury Department in charge of the collectors of the various ports, who are required to visit and inspect them, at convenient seasons; to see that the respective keepers are faithful in the performance of their duties; that the contractors for oil, lamps, &c., conform to the letter of their contracts; that the public property is kept in good repair and preservation. Now, it must appear evident to every one that, however desirous the collectors of the great commercial ports may be to fulfil this part of their official duty, with proper regard to the public interest, it is utterly impracticable for them to do so, for the reason that their whole time and attention is absorbed in more urgent duties. Some of the collectors of the minor ports, whose limited occupations at the custom-house may allow them leisure to examine with due care the light-houses under their particular charge, doubtless endeavor to fulfil the trust; but that the collector of the port of New York, for instance, who is charged with the superintendence of ten or twelve light-houses, and a great number of buoys, beacons, &c., some of them placed at distances of more than two hundred miles apart, can possibly give any of his valuable time to the business, is, according to our view, entirely out of the question. The collectors of Boston, Philadelphia, Baltimore,
Charleston, Savannah, Mobile, and New Orleans, though having less of the public revenue passing through their hands, must be equally occupied at their several offices.

Admitting, then, that the collectors of the smaller ports may find leisure and inclination to inspect the light-houses, &c., within their respective districts, and those holding similar appointments at the large commercial cities cannot, it follows that the light-houses of last importance are supposed to be attended to, while those lighting the channels to our great commercial resorts are unavoidably neglected.

We do not mean to impute to the Treasury Department or the collectors the slightest intentional neglect; on the contrary, it must be a matter of surprise that, under the present organization of the light-house system, the Department at Washington has been able to preserve so much order and economy. When we consider the multifarious duties imposed upon the Secretary of the Treasury and his assistant Auditors, labors certainly sufficient to authorize in Europe the establishment of a half dozen bureaus, we cannot but be astonished that the superintendence of light-houses should be added to their already overwhelming responsibilities.

It is desirable that the present executive and financial departments of the system should be retained; that the Secretary of the Treasury should continue as the chief director of the whole; the Fifth Auditor still exercise his experience in the management of its civil and financial concerns, and the several collectors act, as heretofore, as agents and disbursing officers; but here their immediate personal agency should cease. So far, the system is unobjectionable; but to render it completely so, nautical men should be employed to superintend those matters that belong more exclusively to the profession. Light-houses, as well as floating lights, buoys, and beacons, are placed for the safety and convenience of seamen; and none but seamen are capable of appreciating the importance of a proper vigilance in the management of these indispensable guides. There are numerous contrivances and modes of communication, known only to the seaman, by which the masters and pilots may be directed, in times of anxiety and danger; and for this and other reasons, none but retired ship masters and mates should be appointed as keepers of lights, whether ashore or afloat.

It is necessary, also, that practical seamen should be employed to anchor the floating lights and buoys, to see that they do not move from their positions, and to inspect, from time to time, the moorings by which they are secured.

Hitherto, the collectors, from their ignorance of such matters, have generally delegated the business of putting down buoys to pilots; who, in the execution of the charge, as it might be expected, have taken care to place them to suit their own convenience, and to disregard the convenience of others. And with respect to light-houses, the same falsity has prevailed, at all events, in this vicinity, where pilots have always been the principal operative agents.

With reference to the existing mode of superintending the various light-houses, we would ask who visits and inspects them? Who sees that the oil is of the best quality? that the buildings and grounds are
preserved from injury? It may be said, in answer, the collectors; but this is not the fact. In very many of the light-houses, the whole charge devolves on the keepers, upon whose attention and integrity depend the good or bad condition of the establishments intrusted to their care. Many of these people are, doubtless, faithful in their duties; others not so.

The contractors visit, at stated seasons, the light-houses for the purpose of delivering oil, examining and exchanging such of the reflectors, lamps, &c., as need repair. By the contracts, these are required to be kept in the best possible order, and the oil to be of the first quality. Now let us inquire, Who inspects the oil when delivered? Who decides upon the condition of the reflectors and lamps? We answer, in most cases, the keepers. We know, from personal examination, that many of the reflectors and lamps, in several of the light-houses, have no spare reflectors; and when it becomes requisite that one should be repaired, it is necessarily sent to an artisan at a distance,* and is sometimes kept away for weeks; thus the brilliancy of the light is diminished, and the anxious mariners made to suffer the consequences.

By a clause of the contract, the contractor is required, when making his annual visit to the light-houses, to deliver oil, &c., to examine into the condition of these establishments, and to report to the Treasury Department whatever of impropriety or neglect may come to his notice. Now, without impugning, in the least, the honesty of the contractors, or the fidelity of the keepers, we may be permitted to remark, is it reasonable to suppose that the whole truth, in regard to these required examinations, is always communicated? In most cases, the keepers are the inspectors and receivers of the oil. They are left to judge, and, if necessary, to complain of the unfaithfulness of the contractors, and the fulfilment of their stipulations. Then how can it be expected that the parties, thus made dependent upon each other for the transmission to the Treasury of reports, whether favorable or unfavorable, of the performance of their respective obligations, should very often exhibit cause of complaint?

But for all these evils there is a simple remedy, which can be applied without deranging the main organization of the system. And this is, to establish a board of inspectors of light-houses, &c., to be composed of four or five naval captains and one engineer. Each of these captains to be charged with the inspection of the light-houses, floating lights, buoys, and beacons, within the boundaries of one of four light-house districts, to be arranged in the following manner:

The first district to extend from New York to the eastern confines of the United States.

The second, from New York to Savannah.

The third, from thence to the southern boundary, embracing all the navigable bays, sounds, and rivers, communicating with or disemboguing into the Atlantic, within the geographical limits of the respective districts.

The fourth, the lakes and western rivers, wherein light-houses, buoys, or beacons are or may be established.

* This information the writer received from the keeper of a light-house in the New York district.
These officers should be temporarily detached by the Secretary of the Navy for this special duty, and placed under the orders of the Treasury Department. The engineer should be exclusively attached to the same Department.

It should be the duty of the inspecting captains to visit and inspect, once in every year, and oftener if necessary, every light-house, floating light, beacon, and buoy, within his respective district, and to make full and complete reports to the Secretary of the Treasury of the condition of the whole, with such suggestions of improvement as he might consider advisable.

The duty of the engineer should be to furnish, under the instructions of the Treasury Department, plans and specifications for such new works as might be authorized by Congress; to superintend the repairs and alterations suggested by the inspecting officers, and sanctioned by the Department; to attend to the purchase and arrangement of lenses, reflectors, lamps, &c., and to the inspection of the oil and other articles required.

It will be perceived that, by this arrangement, no changes are proposed in the administration of the light-house department; but simply an enlarged system, by which those who at present conduct that branch of the public service would have efficient aid in the fulfilment of their important duties. In truth, the Light-house Board would be nothing more than an appendage of the Treasury Department, acting under its authority.

As naval men, they would be always competent to the duty, and while employed in their tours of inspection, would necessarily, as a part of their business, become familiar with all the peculiarities of the coast, the various shoals, channels, and harbors; an advantage of the highest consideration, and which at some future time might prove to them as commanders of vital importance, and possibly be the means of saving them from shipwreck or capture.

The employment of the proposed board would impose no additional expense on the Government, nor would it interfere in the least with the naval duties of the captains. On the contrary, a saving would be effected by the increased care and vigilance of the light-house keepers; and the naval captains, as we have before remarked, would be immeasurably benefited by the valuable hydrographical information obtained; and should one or more of these captains be wanted by the Secretary of the Navy for command or other duty, others could be conveniently ordered to fill the vacancies, thus giving to each in turn the benefit of this instructive service.

If the engineer to the board should be taken from the corps of engineers, then, of course, he would receive his usual pay, in like manner with the captains, from the particular department to which he belongs; but if especially appointed for this duty, his salary might be considered as an additional charge upon the light-houses, but it would be more than balanced by the saving produced by his services in furnishing plans and specifications, superintending repairs, &c.

M. C. PERRY,
Captain United States Navy.
Letter of Lieut. T. A. Jenkins.

Coast Survey Office,
Washington City, D. C., November 5, 1851.

SIR: In conformity with your instructions, transmitting a circular letter from the Light-house Board, I have respectfully to report:

1. That the French lens lights at Navesink, New Jersey, and Sankaty Head, Nantucket, are, in point of brilliancy and range, far superior to any other lights I have seen in this country.

2. Not having seen the English lights on the Bahama banks recently, nor the light on the Moro castle, at Havana, since it has been fitted up with a first-order lens apparatus, I cannot compare them with the lens lights of Navesink and Sankaty Head.

3. The best reflector sea-coast lights of the United States which I have seen are not equal to the third-order lens light on the Brandywine shoal, Delaware bay, in brilliancy and usefulness.

4. The lights of France, England, Scotland, Ireland, and those of the maritime nations of Europe in general which I have seen, (a large number of them being fitted with the lens apparatus of Fresnel,) are far superior to the lights on the coasts of the United States. The Sankaty Head, Navesink, and Brandywine Shoal lens lights are not inferior to the lights of the same classes in general in Europe, although there are many of the European lights which are greatly superior to them.

The other aids to navigation, consisting of floating lights, beacons, buoys, range marks, &c., in England, Scotland, Ireland, and France, are kept up in a better and more efficient manner than they are in this country.

The floating lights of the United States have lamps with large solid cord wicks, flat wicks, and, in some instances, circular wicks, fed by capillary action, and the external current of air only, to produce good combustion and a clear bright flame—an impossibility. "Before Argand's time every wick consisted of a solid cord, whose flame was fed only by the current of air outside; and the consequence of this arrangement is, that the stream of vapor or smoke, especially from the centre of thick wicks, escapes unburnt, because, before it reaches the height at which the combustion of the central stream can take place, its temperature has become too low to admit of its ignition."

The floating lights of the United States are all fixed lights.

In England especially, the floating lights are fitted with Argand lamps and parabolic reflectors, with a fair proportion of them revolving, as a distinction.

The buoys in the United States are too small as a general rule; badly painted, of improper shapes, and often improperly moored.

The beacons are not properly painted and distinguished from each other, and they in general only serve to aid those familiar with the local navigation.

5. The question cannot be fully answered by me now. Not less than four buoys are required, of a large size, to mark out the channels on the Frying-Pan shoals, (Cape Fear.) A light-boat, fitted with the best Argand lamps and parabolic reflectors, should be safely moored in the
neighborhood of the outer end of these dangerous shoals, to serve as a guide to the navigator in passing them.

6. The following lights require to be improved, and there should be no unnecessary delay in accomplishing it:
   Cape May, revolving light.
   Cape Henlopen, fixed.
   Smith's island, (Cape Charles,) revolving light.
   Cape Henry, fixed light.
   Cape Hatteras, fixed light.
   Cape Lookout, fixed light.
   Cape Fear, Bald Head, fixed light.
   Cape Romain, fixed light.
   Charleston, S. C., revolving light.

These nine lights are not second in importance to any on the coast of this or any other country, and humanity and true economy demand that the towers of each of them should have an elevation of one hundred and fifty feet above the level of the sea; and that they should be fitted up in the best manner with first-order lens apparatus, to insure a brilliancy and range adequate to the wants of commerce.

These lights are not sufficiently well distinguished; but a general plan for all the sea-coast lights will best accomplish that object.

7. In cases where the towers remain in the natural state of color of the materials employed in their construction, and where they are uniformly white, on an extended low coast without headlands or other prominent objects to guide the mariner, they should be distinguished by colors, having due regard to the objects forming the back ground.

8. The law at present prescribes the best colors for buoys; black to port, red to starboard on entering a bay, river or port, with red, black, and white stripes, according to positions and dangers to be marked.

The buoys are in general too small. Can and nun buoys are believed to be the best shapes, but they require perches, numbers, &c., sufficiently distinctive at as great distances as they ought to be seen. Spar buoys are only adapted to a few special positions, and are in general inefficient.

Well-made iron buoys (both nun and can) moored with blocks, sinkers, or screws of proper weights and sizes, with well-tested chain cables, of proper length and size, are believed to be the most economical. Duplicates are clearly necessary to enable the officers in charge of them to keep them well painted and numbered.

9. Red, black, and white, singly and in combination, will afford all the necessary distinctions for towers and leading marks to enter intricate channels, &c. A regard to the back ground must be had in all cases. Red and black show well on the water; white upon dark back grounds, the sky, forests, &c., while the sun shines, and the observer is in the position to have the benefit of the reflection; hence there may be combinations by broad horizontal and perpendicular lines, to form all the distinctions which navigators may require.

Leading lights are generally too close to each other; as examples, the two on Oak island, and the two at Price's creek, Cape Fear, may be cited.

Leading marks on land, for ranges, and all buoys should be of such
forms, colors, and dimensions as to insure their special characteristics being recognized without difficulty.

The towers of all sea-coast lights, especially on low coasts, should be as marked in their characteristic distinctions by day as the lights are by night.

Having been employed during the three past seasons in the vicinity of Capes Hatteras and Fear, in charge of a hydrographic party, I had ample means of ascertaining the general state of the atmosphere near those localities, relatively to that of other parts of our own and of foreign coasts, especially with reference to the assumed greater amount of haze, mist, &c., there, arising from their proximity to the Gulf stream, calculated to impair the usefulness and brilliancy of the lights on our southern coast.

Having learned that such an idea had been suggested, more than ordinary care and attention was given to the subject, which resulted in the irresistible conclusion that no such cause had any real existence.

The lights of Capes Henry, Henlopen, Hatteras, and Fear were seen under almost every possible state of the atmosphere; in calms, in gales, and with the wind from every different point of the compass; at the greatest distances at which they could be seen, and from the closest proximity to them.

The generally admitted inferiority of these lights can only be properly attributed to the bad apparatus employed in them, and to the want of knowledge and instruction on the part of those employed to keep and superintend them.

If additional evidence were required to prove the fallacy of the assumption that these lights are not good in consequence of the state of the atmosphere being worse than elsewhere, it would be found in the undeniable fact that the English reflector and refractor lights on the Bahama banks (almost within sight of the coast of Florida, and the Gulf stream being equally near to all) are far superior to those on every part of our coast, with the exception of the lens lights at Sankaty Head, and the Highlands of Navesink.

In replying to the queries of the Light-house Board, I have confined myself (so far as the questions propounded would allow) to the limits of the sphere of my hydrographic duties.

I am, very respectfully, your obedient servant,

THORNTON A. JENKINS,

Prof. A. D. BACHE, LL. D.,
Supt. U. S. Coast Survey, &c.

Letter from Captain H. K. Davenport, United States Navy, commanding the United States mail steamer Cherokee.

NEW YORK, May 18, 1852.

DEAR SIR: In reply to the circular of the Light-house Board, I beg leave to bring to your notice all the information I possess in reference to the subjects therein mentioned.

48 L H P
I generally make one passage per month from New York to New Orleans, running occasionally to Chagres via Havana and Kingston.

I frequently make the following lights, viz: Barnegat, Little Egg harbor, Body's island, Cape Hatteras, Cape Lookout, Cape Romain, Charleston, Martin's Industry light-ship, Tybee, Cape Canaveral, Carysfort light-ship, Cape Florida, Double-headed Shot-key, Gun-key, Moro Castle, (Havana,) South and Southwest Pass lights at the mouth of the Mississippi river.

The Navesink lights are by far the best on our coast which have come under my observation, particularly the revolving light, which can be seen twenty-five miles. This light compares favorably with that on the Moro Castle, (Havana,) the best on this side of the Atlantic.

Barnegat light is but an indifferent one; is frequently mistaken for a vessel's light; in hazy weather cannot be seen more than seven miles. Vessels bound to New York from the South generally run for this light, and it is of great importance that it should be a first-order light, and so arranged as not to be mistaken. I think a flash light would be preferable. As for Egg Harbor light, that had better be "put out" than kept as it is now, a decoy to draw vessels into difficulty looking for it. It is not as bright as the light I carry at my masthead. Body's island, a flash, is a pretty good one; can be seen twelve miles from the top of our wheel-houses, but the period between the flashes is too long. The steamers going South frequently make this light; it serves as a guide to Hatteras, and it should be a first-rate one.

Cape Hatteras light, upon the most dangerous point on our whole coast, is a very poor concern; frequently cannot be seen outside of the shoals off the cape. Vessels going south hug the land to keep out of the influence of the Gulf stream, which runs near the shoals; and it is of very great importance that there should be a first-class light at this place, as well as a light-ship or bell buoy on the outer point of the shoals. I have seen Cape Lookout but once, twelve miles off, in clear weather. The light at this place ought to be improved, as a dangerous shoal makes off some eight or ten miles. Baldhead light I have never seen, although I frequently pass Frying-pan shoal in nine fathoms water. A light-ship off this shoal would be of incalculable service to coasting vessels. One provided with good moorings, anchored on the "Pan," ought to stand the heaviest weather.

Cape Romain is a tolerably good light; might and ought to be improved; a bad shoal makes out six or seven miles from this place. Charleston light (revolving) can be seen between twelve and sixteen miles; answers very well; the beacon is of but little use as kept at present. The light-ship on Martin's Industry (a dangerous shoal) shows a light about equal to an ordinary street light before the introduction of gas; can be seen when almost on it; had better be removed if not improved. Vessels knowing a light to be there run for it, and are frequently caught foul before they see it. Sufficient care is not taken in placing our light-vessels. The ship at this place is supposed to be on the extreme edge of the shoal, but some time since I touched in a vessel drawing seventeen feet water, about half a mile outside of the light-
ship. Tybee light answers very well, as the water is bold close up to the bar; it can be seen twelve miles.

Cape Canaveral (revolving) is a good light. I have seen it, bearing west by south, from eighteen fathoms water. There are some dangerous shoals recently discovered off this cape; the light ought to be of the first order. I beg leave here to suggest the importance of a good light on Point Jupiter; there are numerous shoals near this place. A light here would serve as a guide to vessels bound south, as well as affording them a known point whence to take a fresh departure. Owing to the influence of the Gulf stream, it is difficult to determine with accuracy the position of a ship, and this light would be a great relief to vessels running along the coast. Cape Florida is a bad light. A year since I took the passengers and crew from a vessel wrecked within sight of the lighthouse; had it been worthy the name of a light, she could not have got on the reef without seeing it. Carysfort light-ship (which has recently been removed, and a good light substituted for it) was of no use, except as a signal for vessels which were fortunate enough to see it before getting ashore, to run away as fast as possible. Double-headed Shot-key and Gun-key lights (English) are very excellent; much superior to any on our coast except Navesink. The Moro light (Havana) is, as I said before, the best on this side of the Atlantic. It can be seen twenty-five or thirty miles, and there is no mistaking it. Those at the mouths of the Mississippi are pretty good; can be seen ten or twelve miles; can be improved to advantage. I have frequently seen Cape Antonio (Cuba) and Morant Point light (Jamaica) twenty miles distant. They are excellent revolving lights.

There is too much sameness in our lights. Vessels often get into difficulty by mistaking one for another. They ought to be so arranged, that, as soon as seen, a vessel could be certain of her position. I have seen the lights in St. George's channel, (England,) which are much superior to any we have; they are distinguished by color—fixed, revolving and double lights. As soon as seen, a vessel knows what light it is, while with us, if no observation has been had for several days, we have to bring to our aid the Yankee practice of guessing the name of the light.

The buoys in and about our harbors are generally too small. They should be much larger, and designated so that any one could know where the channel was, as well as the shoal spots.

I do not know that I have answered all the queries contained in your circular as fully as they ought to be, or as the subject demands. My knowledge of the technical names for the different kinds of lights is very limited, but the following are the Fresnel lens: Moro Castle, Cape Antonio, (Cuba;) Morant Point, (Jamaica;) Double-headed Shot-key, and Gun-key, (English.)

I am, very respectfully, your obedient servant,

H. K. DAVENPORT.

Lieut. T. A. JENKINS, U. S. N.,
Secretary of the Light-house Board, Washington.
Office Light-house Board,
May 24, 1851.

Sir: I am instructed by this board to address a communication to the Treasury Department, asking for information from the proper officer in relation to the present system of construction, illumination, inspection, and superintendence of the lights, &c., of the United States, and have respectfully to request that the necessary directions may be given to obtain the desired information.

Classification.

What is the present system of classification of lights in the United States? What number of the different classes? By what system or rule are the classes determined with reference to power or intensity; number of reflectors and burners; size of reflectors and burners, or geographical position?

What number of lights are there on the sea-coast classed as first-order, or class lights? What the diameter of the burners? What the diameter of the reflectors? What number of lamps and reflectors of the largest sizes for a light embracing the whole horizon, three-fourths, one-half, and less arcs of the horizon, in each of these lanterns?

Please furnish a list of the light-houses at present existing in the United States, in each separate class respectively, and also a list of those commenced but unfinished.

Distinguishing Characteristics.

What modes of distinction have been employed hitherto, and what at present? Please furnish a list of lights, with their different distinctions. What has been the result of experience and trials of the different modes of distinguishing sea-coast and other lights, with reference to economy and efficiency, such as single, double, and triple fixed lights; two fixed lights in one tower, one above the other, white or colored; single fixed and revolving or other movable light, in towers adjacent to each other; single, revolving, flashing and intermitting lights, colored lights, white and colored combined in separate towers, and a beam of partly red and partly white light, transmitted to the horizon from the same burner or lens, and the means employed to accomplish it? What colors are employed as distinctions in the lights of the United States? Please specify the number of colored lights now existing, and the different colors employed.

How are the colored lights produced? Are the tubes or chimneys white or colored glass for colored lights?

What means are employed to prevent loss of light through colored media by absorption?

Positions of Light-houses and Light-Vessels.

What means are employed to ascertain the proper positions for light-houses and light-vessels? By whom are such positions selected, and by whom are the persons designated for this duty appointed?

By whom are the sites for light-houses selected and their use obtained in special cases?
CONSTRUCTION, PLANS, AND DRAWINGS.

How are plans for towers, dwellings, light-vessels, and beacons procured; under whose direction, and by whom approved or adopted?
Copies of specifications and working-drawings for special and general cases, or for the several classes of towers, are requested.

ILLUMINATION, &c.

The illuminating apparatus, lanterns, machinery for movable lights, and other accessories—how determined upon; by whom; how procured; by whom selected and tested as to quality of material, perfection of shape, pattern, and workmanship; by whom placed in the towers; by whom superintended while being fitted or placed in position, and by whom and to whom reported ready for use?

What number of lens or Fresnel lights are there in the United States at present? Please give the names of the localities, class of the lights and number of keepers to each, with the dates at which they were respectively lighted for the use of mariners. How often have these lights been reported out when they should have been lighted? How often have they gone out at night since they were lighted? The causes which produced the extinction, and any remarks that may be applicable to the case. What is the annual average expense of keeping the Carcel or French mechanical lamps used in the lens light, in repairs? How often do they require renewing? By whose direction are the repairs made upon the lamps of the lens lights?

Have the hydraulic or pneumatic lamps been introduced into the lens lights in the United States? Is there any objection to their use in localities adapted to them? What difficulties have been encountered at Navesink, in the management of the lens lights?

How are the reflectors and lamps placed on the frames?
Please specify in detail what number of lights, other than sea-coast lights, (with reflectors,) including beacons, are used as leading marks in the vicinity of anchorages.

By whom, and upon what principle, are the reflectors in general use in the lights of the United States manufactured?

What is the proportion of silver to the pound avoirdupois of copper, used in the manufacture of the first, second, third, and fourth qualities of reflectors in use in our lights, and what the cost of each size and quality in use?

Are there any reflectors in use of an inferior quality, such as heavily or thinly plated ones? If any, what is their cost, specifying sizes, and how long do they last without being resilvered?

What means are employed to secure the most perfect form in the reflectors? By whom tested, with reference to form and finish?

What description of lamps are in general use, and what the exceptions? What the diameter of the burners in most general use? Of what materials are they constructed? Are the burners tipped with silver to prevent rapid decay from the action of the flames, or what other means are employed to insure the greatest durability possible?

How, where, and by whom are the lamps placed in the foci of the re-
flectors, and the whole placed on the frame? What is the general rule or plan for placing the reflectors, by which to insure the transmission to the horizon of the greatest amount of light? By whom inspected? By whom and to whom reported prior to lighting?

What is the cost of the best 21-inch reflectors, with the best lamps in use attached? What proportion of the two metals? How long will they last and transmit the light, without unusual loss from deterioration produced by cleaning? How are the lamps and reflectors attached? What precautions observed in their fabrication, to prevent their getting out of adjustment by being handled by the keepers in cleaning them?

Have any of the lamps with reflectors known in England and Scotland as Mr. Alan Stevenson's pattern, been introduced into our light-houses?

What illuminating apparatus is used on board of our light-vessels?

Are Argand burners and lamps fitted on gimbals in use on board of our light-vessels? What description of apparatus is used in our light-vessels? Please describe it in detail, and specify the amount of oil consumed per annum. How long will the burners to the best lamps in use remain without requiring repairs, and how long without renewing?

What is the average annual expense of repairs per lamp (reflector lights) for the lamp alone? What the annual cost per lamp and reflector for polishing materials, buff-skins, cleaning-rags, &c.? What is the average number of gallons of oil consumed per lamp per annum? Specify particular lights, and the diameter of the burners; the average number of hours each lamp was kept burning per annum.

SUPPLIES, &c.

By whom are the wants of lights supplied? How often are the lights visited, for the purpose of furnishing oil and other requisites? Who determines the wants of the lights, the quantity and quality of the oil to be delivered? What tests employed to insure a good quality, and by whom is the oil tested? By whom are the wicks, tube-glasses, buff-skins, glass, and other accessories procured, inspected, and delivered?

What is the established system of internal economy for towers and buildings, such as painting, whitewashing, repairs. &c.? What system of alarm-signals is employed in foggy or hazy weather? What is the mode of relief for the shipwrecked, at or near light-houses? How and where are the oils and other supplies kept in the light-houses? Are there special oil-cellars in each tower? Any regard paid to the subject of keeping as nearly an equable temperature in the places appropriated for oil as possible? Of what materials are the tanks or other vessels used for keeping oil made? What is considered the most economical and safest means of keeping oil? Do losses often occur from leakage?

LANTERNS, GLAZING, &c.

Of what materials are the lanterns of the light-houses in the United States constructed? Please specify exceptions to the general rule.

What would be the difference of first cost of lanterns constructed of bronze, (gun-metal) or ordinary iron, taking the same class or dimensions for each description of material in comparison? Are there, or
not. many advantages in the use of bronze over that of any other metal for this purpose, especially with reference to repair, painting, and, finally, to lightness of sashes or astragals, by which much less light is absorbed and obstructed than from heavier sashes or astragals?

What description of glass is used for lanterns—French, English, or American plate-glass, or common glass?

What are the usual dimensions of the glass for lanterns of sea-coast lights? What the largest sizes, and what the smallest, for all lights?

What the sizes of the sashes or astragals?

Are the astragals horizontal or diagonal? How is the glass placed in the lanterns—by glazing, or otherwise? Are the lanterns kept painted in the interior; and of what color? How often painted, and under what inspection? What precautions are taken to enable the keepers to replace broken panes of glass without delay? Are the necessary materials kept at hand for this purpose?

What system of ventilation is in use—a general or varied system? Please describe each mode by which a proper ventilation, and as perfect combustion as may be, is obtained. Have any of Professor Faraday's ventilating tubes been introduced into the light-houses of the United States?

**ATTENDANCE UPON THE LIGHTS, &c., TO SECURE EFFICIENCY, CERTAINTY, AND CLEANLINESS.**

How are the keepers appointed? How many to each light? Specify exceptions to general rule as to number to each light. Are keepers instructed in their duties, previous to entering upon them? For how long a period, where, and by whom?

Are keepers supplied with printed or manuscript detailed instructions, to guide them in the performance of the various duties of lighting and extinguishing lights, fitting wicks, filling lamps, trimming, cleaning, keeping the flame in the proper focus of the reflectors and at its normal height; times for executing the different duties during the day; cleaning reflectors; cleaning and keeping machinery for movable lights in order; best means of getting ice and snow off the glass of the lantern, dampness off the reflectors before lighting up, and using the ventilators, to insure perfect combustion without producing unsteady lights? If any in printed form, where ordered to be placed in the towers, lanterns, and dwellings, to attract the attention of keepers and assistants? Copies of all instructions for inspectors—those charged with the delivery of oil and all other supplies, and for keepers and assistants, are requested.

How often are the towers painted or whitewashed outside and inside? By whose order for special times, and to whom reported when completed? By whom inspected, and reported if not properly attended?

What distinguishing marks are employed to guide mariners by day—by different colors, stripes, squares, flags, balls, &c.? Please state the number and names of towers thus distinguished, and the distinction employed at each.

How are alarm signals made in foggy and hazy weather—by machinery, natural agencies, or by hand? Specify in detail, as far as may be practicable, and enumerate each case in the United States.
CONSTRUCTION.

Is there any general system of construction for special localities, by which each locality or description of locality may be said to be adapted to a particular description of material for foundations and super-structures? Please give in detail the modes employed in general, specifying the exceptions by name and location. How is the kind of tower for special localities determined; by whom the working-drawings and specifications, upon which the contracts are based, made; under whose authority and direction, and by whom approved?

Are towers for lights and beacons built in general by contract, embracing the entire work—by contract for the materials, and the work executed by day labor, or by purchase in the open market and day labor? Please state objections or advantages of each separate mode. By whom is the work superintended while under construction? By whom are the materials inspected before being received, and to whom reported if not of good quality? If by contract, please state in detail the various means employed to insure a faithful execution of the work.

Are conductors attached to light-house towers and to the masts of light-vessels? If any, what instructions are given in relation to placing them?

What means are employed to restore impaired or threatened foundations to light-houses and beacons? By whom are examinations made; to whom the results reported? How are plans and estimates, and by whom, made; how contracted for and superintended? These include sea-walls, breaches, drift-sand, undermining by unusual tides or heavy gales, and such like casualties.

How are repairs in general to towers, buildings, sea-walls, &c., made; how the necessity ascertained for making repairs; to whom confided; under what limitations and restrictions, as to character, plan, and expense?

LIGHT-VESSELS, BUOYS AND SEA-MARKS.

How are light-vessels procured? What rule obtains in regard to models, internal arrangements, lighting apparatus, &c.? What length of time, on an average, will a light-boat last, and what the average annual amount of repairs in the most exposed positions, and what for those in sounds, bays, rivers, &c.? What the first cost per ton of light-vessels? How many persons are employed on board the light-vessels in the most exposed situations, and in the least exposed ones? Please specify the rates and amounts of pay and subsistence to each individual, including every item of allowance. How often are light-boats removed for renovation and repair? What number of extra vessels are kept to replace those driven from their moorings, and where kept in readiness for service? Which light-boats are kept at their moorings during the entire year; which removed; when and where replaced? How are light-vessels and buoys moored, and by whom? Please describe the different kinds of moorings, weights, sizes of chains, &c.? How often are moorings of light-vessels examined as a security against damage from gales, and by whom? How often renewed as a general rule? Is there any system of relief for the
masters, mates, lamp-lighters, and crews of the light-vessels? Are the
masters required to live on board, or can they delegate their authority
to deputies? What class of persons is employed as masters of light-
vessels—seamen, or others? What system of inspection, and by whom
made; how often and to whom are reports made of good or bad
condition?

Please furnish copies of printed or other instructions to masters and
others charged with the light-vessels, and lights on board of them, in rela-
tion to the routine duties, examination of moorings, &c.

MEANS EMPLOYED TO ASCERTAIN PROPER POSITIONS OF BUOYS, BEACONS,
AND SEA-MARKS.

How are buoys placed; taken up for renovation and replaced; by
whom and by whose order? How are buoys distinguished? What de-
scriptions of buoys are in general use; size, shape, materials of which
composed, &c.? How is it ascertained when buoys have been car-
ried away from their proper positions? What authority is required to
have them replaced? How are buoys procured to mark positions known
to be dangerous, arising from casualties or recent discoveries in hydro-
graphic operations? Are buoys placed, under any circumstances, in
new positions, without special appropriations or acts of Congress?
Please furnish a correct descriptive list of beacons, (other than those
lighted,) buoys, and all descriptions of sea-marks, if in possession of the
Department; and if no such correct list exists, then specify the best
mode by which it can be obtained.

How often and by whom are the localities of buoys visited to ascer-
tain if they are in the proper positions, and how ascertained; by angles
between known points and soundings, cross Bearings, or by what other
means?

Who is authorized to change the established position of a buoy, placed
to mark any channel or hidden danger, and when changed what means
are employed to give notice of such change to mariners?

At what date are buoys raised in different localities, to prevent them
from being carried away by ice; when replaced; by whom; by whose
direction, and how made known to mariners?

How is the expenditure for placing, replacing, painting, numbering
and repairing buoys, made; by whom and under what limitations and
restrictions to insure the faithful performance of the duties, and a rigid
economy of money?

What number of tenders and boats, if any, are there attached to the
light-house establishment?

Please give the names and locality of each, with the number of per-
sons employed, and the specific duties assigned to each one of them, the
first cost and annual expense of them.

MISCELLANEOUS.

How are notices given to mariners, and how long a time in advance
of the lighting or placing new lights and buoys, erecting beacons and
other sea-marks, or extinguishing and changing old lights?
Are such notices published in the commercial papers, distributed at home and abroad; to whom and by whom, and what special means employed to insure a wide dissemination?

How many inspectors of lights, beacons, and buoys, and other aids to navigation, are there at present? Who besides the collectors of the customs perform this duty?

What number of persons are employed in connection with the lights illuminated with gas, other than keepers and assistants? What number of gas-lights are there? What classes, and how do they compare in relative efficiency and economy with other lights? What number of employés, in addition to the usual number of keepers, are required for the gas-lights?

How many light-house districts are there, and how are they defined?

What amount is paid annually for commissions and expenditures and inspections, and to whom?

How often, under what rule, and in what manner, are inspections of lights, &c., made? What questions or series of questions are propounded by inspectors to keepers, and to whom are the results of these inspections reported for approval of good condition or remedy of defects?

All the information in the Department in relation to the employment of gas, chemical lights, different oils, such as sperm (best winter-strained and summer) oil, other fish oil, lard oil freed from stearine, cotton-seed oil, rape-seed or colza oil, the various mixtures of the oil of turpentine and alcohol, and any other combustibles for illuminating light-houses, the notice of which has been brought to the Department, is desired.

The board, with a view to the regulation of its movements, respectfully requests to be informed at about what period it may expect the information asked for in this communication.

Very respectfully, your obedient servant,

WM. BRANFORD SHUBRICK.

President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury, Washington, D. C.

TREASURY DEPARTMENT.
Fifth Auditor's Office, May 27, 1851.

Sir: I have had the honor to receive your letter of this day's date, enclosing one from the president of the board for examining light-houses, calling for a great variety of information, the most of which is contained in the reports and papers with which I furnished them since the date of their letter. There are other items of information called for by them, not yet furnished, which requires research; and I cannot, therefore, say with any precision when my answer can be sent to them; it will probably not be for two or three weeks. I shall be happy if I can prepare it sooner.

I have the honor to be, sir, very respectfully, your obedient servant,

S. PLEASONTON.

Hon. Thomas Corwin,
Secretary of the Treasury.
TREASURY DEPARTMENT, May 28, 1851.

SIR: Having referred your letter of the 26th instant to S. Pleasonton, Esq., the general superintendent of the Light-house Establishment, I am advised by that officer that it will not be in his power to furnish all the information within the scope of your inquiries before two or three weeks.

A copy of his letter is herewith enclosed.

Very respectfully, your obedient servant,

THO. CORWIN,

Secretary of the Treasury.

Com. Wm. Branford Shubrick,

President, &c.

---

TREASURY DEPARTMENT, June 7, 1851.

SIR: I herewith enclose a communication under this date, from the Fifth Auditor, respecting the present state of the Light-house Establishment in the United States.

Very respectfully, your obedient servant,

THO. CORWIN,

Secretary of the Treasury.

Com. Wm. Branford Shubrick,

President Light-house Board, Washington.

---

TREASURY DEPARTMENT.

Fifth Auditor's Office, June 7, 1851.

SIR: I have had the honor to receive your letter of the 24th ultimo, enclosing one from Commodore Shubrick, president of the Light-house Board lately constituted, asking a variety of information in relation to our Light-house Establishment.

With the view to give the board the fullest information in my power, concerning our Light-house Establishment, I have thought it proper to recur to the first law upon the subject, passed 7th August, 1789, soon after the adoption of the Constitution, and to detail what has been done under it.

This law authorized the Secretary of the Treasury "to rebuild, when necessary, and keep in good repair, the light-houses, beacons, buoys, and public piers in the several States, and to furnish the same with all necessary supplies." This authority was afterwards transferred to the Commissioners of the Revenue, and to me in the year 1820. The law also authorized the Secretary to agree for the salaries, wages, or hire of the person or persons appointed by the President for the superintendence of the same. Under this law the collectors of the customs the most convenient to the light-houses, without regard to their collection districts, were designated, first by the President, and afterwards by the Secretary of
the Treasury, as superintendents of lights, &c., to act under the general head at the seat of Government. They were appointed, as stated in some of the letters to them, "as the natural guardians of the commerce of the country." They were allowed first 5 per cent., and afterwards 2½ per cent. on their disbursements, limited by the law of 23d May, 1828, to $400 per annum. Here is the system since the adoption of the Constitution, which has prevailed in this country, for taking care of the light-houses, buoys, &c., at once simple, cheap, and effectual. The collectors having moneys in their hands, generally, with which to pay the expenses for which they were accountable under their custom-house bonds, no losses have been sustained on account of light-houses by the Government; and these officers, always intelligent and respectable men, have been found willing and even zealous in the discharge of their light-house duties, notwithstanding the inconsiderable compensation they received for it prior to the general appropriation act of the 30th September, 1850. By that act, every collector whose compensation as such amounted to $2,500 per annum, which comprised those charged with the greater part of the light-house duties, were cut off from all compensation whatever for those duties. How this may operate upon this valuable class of officers whose services are thus considered worthless, remains to be seen. The keepers' salaries were fixed by a law of May 23, 1828, at an average of $400.

Under the direction of the general superintendent at the seat of Government, these officers, when light-houses were authorized to be built in their respective districts, selected, with the aid of retired pilots and ship captains, the most suitable sites, purchased the land necessary for the buildings, obtained cessions of jurisdiction from the States, advertised for proposals or plans, furnished by the general superintendent, accepted the lowest bids, appointed suitable mechanics as overseers of the work, day by day as it progressed, and paid no part of the money until the overseers certified that it was well done. It is the duty of the superintendents, also, to visit all the light-houses in their respective districts once a year, and report their condition and the conduct of the keepers to this office.

For convenience, these plans comprised four classes of towers, viz: sixty-five feet, fifty feet, forty feet, and thirty feet high, the particular dimensions of all of which are mentioned in my reply to a speech of Mr. Profit, which will be found in the report of the Committee on Commerce, No. 8, page 75. There are four classes of reflectors, also, viz: 14-inch, 16-inch, 18-inch, and 21-inch diameter, made in moulds or dies, in the best manner, and with which I have caused nearly all of the old light-houses to be fitted since the year 1840, and all the new light-houses which have since been built. A copy of the contract for making these reflectors, with lamps, chandeliers, &c., at Boston, is herewith transmitted. The silver to be put on the reflectors is weighed, and the lamps and reflectors are fitted upon the chandeliers under the inspection of William A. Wellman, Esq., an officer of long experience, and the assistant collector at Boston, before they are sent to the light-house for which they are wanted. They are then sent and fitted in the lanterns by a mechanic well acquainted with the subject. That the reflectors are a
true parabola, I possess the certificates of Mr. R. H. Eddy, a civil engineer of distinction at Boston, and Mr. George F. Wilson, of Providence, Rhode Island, appended to a diagram of the reflector.

I have also within the last ten or twelve years substituted in most of the light-houses on the seaboard new lanterns with large French plate-glass, generally 16 by 28-inch panes, and sometimes much larger, for the old lanterns, with thick sash and small panes of Boston glass, by which the lights probably have been as much improved as by the new reflectors. French plate-glass is used because all other changes color and becomes opaque by being exposed to the sun and salt air.

It must be apparent to all who reflect upon the subject, that I have had much inconvenience and difficulty to encounter from the frequent changes incidental to our form of government, in the light-house keepers, who for a time do not understand the management of their lamps, and consequently keep bad lights and waste much oil. So necessary is it that the lights should be in the hands of experienced keepers, that I have, in order to effect that object as far as possible, recommended, on the death of a keeper, that his widow, if steady and respectable, should be appointed to succeed him; and in this way some thirty widows have been appointed.

The Light-house Board, I hope, will visit and examine all the lights from Maine to Louisiana, without which it will be impossible for them to do justice to the establishment. Having myself, some years ago, examined most of the lights from Cape Henry to Maine, and for a part of the distance taken Governor Davis, of the Senate, and Mr. Bancroft, collector of Boston, with me, both of whom, as well as myself, found the lights generally in most excellent order, well attended to by the keepers, and satisfactory to navigators, (see House Doc., No. 62, 1st session 28th Congress,) and having from time to time since received favorable reports from the superintendents and other persons whom I have sent to examine them, I feel not the smallest doubt that the board will, as a whole, find cause to commend the establishment. That defects will be found in some cases may be expected. One of these is known to me, but it has not been in my power either to prevent or to correct it. It is the building of too many lights in some places on the eastern coast; and of this evil, a visit by the board would enable them to recommend to Congress the correction.

To facilitate the inquiries of the board in its examination of the lights, I have caused to be copied and laid before it a list of the several collectors acting as superintendents, the light-houses, &c., under each, with the names and salaries of the keepers of the light-houses and light-vessels.

*French lenses.*

We have but three light-houses fitted up with lenses made in France. There are two at the Navesinks, near Sandy Hook, of the first and second orders—one stationary, and the other revolving, with flashes. They are attended by five keepers—a principal at $600, and four assistants at $360 each. In France the same number could be employed for
about $600. The two consume upon an average three gallons of oil per night.

The third is at Sankaty Head, on the Island of Nantucket, and is a revolving light of the second order, exhibiting red and white flashes. A principal keeper here receives $600, and two assistants $500 each. The lamps used in these lights are "Carcel," made in France. The keeper at the Navesink, where they were first put in operation, being a machinist, was supplied with tools, with which to repair the lamps, of which he had one or two spare ones. These tools were handed over to his successor, so that there are no expenses found in the accounts for repairs. The lamps of the one at Sankaty Head have not been long enough in use to require repairs. At least there are no charges in the accounts for repairs.

Believing that if any of the lenses could be employed with advantage in any of our light-houses, it would be those of the third order, I recommended to Congress, through the Committee on Commerce, an appropriation for one of that order, to be placed on the inward light in Boston harbor, so that scientific and nautical men living in that city could examine it from time to time to determine its value. Congress, however, omitted to grant the appropriation. The letter from this office to the committee will be found in the report of the Committee on Commerce of the House of Representatives, No. 8, p. 39.

* * * * * * *

Oil and other materials for lighting

All the oil, tube-glasses, wicks, buff-skins, tripoli, lamps and reflectors, and parts of lamps, and oil butts, are procured twice a year by the collector at Boston, by advertisement, and forwarded to the light-houses on the Atlantic coast, formerly by one vessel, but now by two vessels, beginning in the spring, at St. Mary's, in Georgia, and going eastward to Passamaquoddy. A lamp-maker is taken on board for the purpose of repairing the lamps, for which he has every necessary material with him.

In the fall of the year the oil and other materials for maintaining the lights are procured in the same manner, and one of the vessels is despatched with them to supply the lights from St. Mary's to Louisiana, inclusive. The captains of the vessels take the receipts of all the keepers for the oil and everything delivered, and forward them to this office. It is their duty also to report the state of the buildings and the apparatus.

The oil is inspected in the manner described by B. T. Congdon, inspector of oil at Boston, in a letter to the collector there, dated December, 1845, written in reply to a complaint of bad oil on the lakes. A copy of the letter is annexed.

The oil and other things used for lighting on the lakes Erie, Huron, Michigan, and Superior, are sent to Buffalo, taken on board of a vessel there by a general inspector of lights, who proceeds with them to all the light-houses, delivers what is proper at each, and takes and forwards the receipts of the keepers to this office. The vessel also carries a lamp-maker, who makes all necessary repairs. Supplies for Lake Ontario
are sent to the collector at Oswego, and those for Lake Champlain to Plattsburg, for distribution. The inspectors, as well as the collectors last named, report the condition of all the lights which they respectively examine, and all in season to have the repairs made before winter sets in.

The average consumption of oil on the Atlantic coast is thirty-five gallons per lamp per annum, which is supplied to each light-house; and as some keepers burn more and others less, the excess is made up from those which can spare it. On the lakes and on the North river, the lights are suspended whilst the navigation is closed by ice, and the consumption of oil there is about thirty gallons per lamp.

Besides the best sperm oil from head-matter, which has always been used in our light-houses, I have made trial of a camphene, by Mr. Greenough, at Boston, and lard oil, at Cleveland, in Ohio. The camphene afforded a beautiful light, but after the lapse of a few months it became decomposed, and was not fit for use. The lard oil burnt very well in warm weather, but as early as October it congealed, and the manufacturer himself, at whose instance it was tried, was satisfied that it would not answer for light-houses.

I was in hopes at one time to have found a suitable and cheap substitute for sperm oil in that form from cotton-seed; for, having tried it in my family, I found it to burn very well when new, but, like all oils from vegetable substances, after a few months it became thick and unfit to burn. So with rape-seed oil, which is used in the French lights, and is supplied every three or four months, whilst the sperm oil will remain good for the space of a year. The freight for supplying our lights on the sea-board annually is about $9,000; and if rape-seed oil were used, it would have to be supplied four times a year, and this item of freight, therefore, would be enhanced to the sum of $36,000. The rape-seed oil, too, must be imported, as I am not aware that any is made in this country for sale; and as it costs in France from ninety-three cents to one hundred cents a gallon, the freight and expenses on it would make the cost nearly as great as the best sperm oil, independently of the increased freight. Besides, it is stated in some of the parliamentary reports that one-sixth more of the colza or rape-seed oil is consumed in the same time. There is nothing in it, therefore, which should give it a preference over sperm oil, which, in my opinion, is the best material that can be used for producing lights in light-houses.

Floating lights.

Of these we have forty-one, stationed in the Delaware and Chesapeake bays, the sounds of North Carolina, and at different places at sea. They are in size from 72 tons to 400 tons, according to the situation at which they are placed. In their formation I have had the aid of some of the most intelligent and experienced ship-builders in the country. The mode of lighting them has advantages over that adopted in the British service. Whilst their lantern is made to go around the mast, and is hoisted and lowered by a windlass, ours is made to run up and down between two masts by means of weights, and kept at the masthead by them.
These, lights, however, ought never to be adopted for any situation in which a light-house can be built for any reasonable sum, for they are not only driven from their moorings often when they are most wanted, but in the frequent and expensive repairs which they require, and in the large number of men necessarily kept on board of them, they are three or four times the annual expense of a light-house of the first class.

Buoy.

The buoys established by law are very numerous, and on many parts of the coast are attended and kept in their places with great difficulty and at considerable expense. Down to the year 1842 they were well attended in the waters leading to our principal cities by the revenue cutters, to the officers of which I gave a few hundred dollars annually, in addition to their ordinary pay, for this service.

But in that year all extra pay from every branch of service was cut off by law, and I consider it improper to ask the Secretary of the Treasury to exact this as a duty from those engaged in the cutter service. In the district of New York a vessel is owned by the Department, and in the Delaware district one is hired, both of which perform this and other duties connected with the light-house department. In other districts proposals are invited in the public papers from pilots, and the contract for a year or two at a time is given to the lowest bidder, which, though unreasonable in some cases, we are obliged to accept. It may be mentioned that no buoy is procured and moored which is not authorized by law. When once authorized, they are replaced as often as necessary.

Gas-lights.

We have four of those lights in the Delaware bay, viz.: Christiana creek, Reedy island, Cohansey, and Egg island. One of them has been in use since 1841, and the other three for several years past. These lights would all be extinguished from three to six months in the year, if oil and oil lamps were not kept at each of them to continue the lights. The keepers were in the habit of suffering the furnaces and retorts to be burnt out before they gave notice to the superintendent of the necessity of supplying new ones, and to provide and put these up required several months. In the meantime, to continue the lights, lamps with oil had to be kept at the light-houses and resorted to. I then ordered a double set of furnaces and retorts at each light-house, in order that one set might be used whilst the other was undergoing repairs; and this produced no improvement, as both sets were burnt out before they gave the necessary notice for new ones. There is room to believe that the keepers were averse to making and burning gas, but preferred the oil lamps. The superintendent consequently had orders, some time ago, to notify the respective keepers that if notice was not given by them in season, to keep the gas-works in repair, it would be cause for removal. What effect this may have is yet to be seen. With ordinary keepers, although the gas from rosin is excessively cheap, it is not advisable in my opinion, to attempt the use of gas in any more of our light-houses;
and to employ scientific men to attend them, would occasion an expense out of all proportion to the benefits to be derived from them.

We have one light-house at Portland, on Lake Erie, lighted with natural gas, carried a distance of two miles in pipes to the tower; and even here we are obliged to keep oil and lamps, as water frequently collects in the pipes, over which the gas will not pass; and whilst they are taken up and freed from water, oil light has to be used. We have a contract for supplying this gas at the annual cost of the oil which would be required, if lighted with that material.

*   *   *   *   *   *   *   *

Having heretofore shown that the cost of maintaining our light-houses annually does not exceed one-third of that of the English, and very little more than one-third of that of the Scotch and Irish, and that the cost of our buildings, on an average, very little exceeds the interest of a single year on the cost of the British and Scotch buildings, I refrain from saying anything further upon the subject at this time. The letter from Commodore Shubrick is herewith returned.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

The Hon. Thomas Corwin,
Secretary of the Treasury.

OAFFICE LIGHT-HOUSE BOARD,
Washington, June 16, 1851.

SIR: The Light-house Board having decided that the reply of the Fifth Auditor of the 7th instant, to the communication of the board of the 24th ult., is not such an answer to the queries contained in that communication, nor does it furnish such information as is desired by the board to enable it to form correct opinions upon the subjects confided to it, I am directed respectfully to request that the honorable Secretary of the Treasury will cause specific answers to be furnished to each of the queries contained in the communication of this board of the 24th ult.; and also to direct that the list of lights, beacons, and buoys, asked for in that communication, embrace a correct description of all the light-houses and light-vessels at present existing, and those now under construction in the United States; specifying the geographical position of each light; the order or class of the light; the number of lamps and reflectors, (if a catoptric light;) the dimensions of the reflectors, burners, frame and lantern; the materials of which the burners and lamps are composed; the names of the keepers and assistants; the date at which they entered upon their duties at the respective light-houses; height of the towers from base to the top of lantern; the height of the light above the level of the sea; date of erection of towers, and lighting of light; when renovated and supplied with new illuminating apparatus; a list of all the dumb beacons belonging to the United States, with a statement of their geographical position, design, descrip-

49 L H P
tion as to material and color; date of erection; and also the position geographically, and by number and color of each buoy; its description, whether spar, can, or nun buoy, of wood or iron.

Very respectfully, your obedient servant,

WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury, Washington, D. C.

TREASURY DEPARTMENT,
Fifth Auditor's Office, July 3, 1851.

SIR: I have the honor to enclose herewith, for the use of the Light-house Board, an answer to all the questions contained in their letter to you of the 24th May, and which were not particularly referred to in my letter of the 7th of June last.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

W. L. HODGE, Esq.,
Acting Secretary of the Treasury.

TREASURY DEPARTMENT, July 5, 1851.

SIR: Enclosed herewith you will receive the answer of the Fifth Auditor to the queries propounded to him in your letter of the 24th May last, for the use of the Light-house Board.

Very respectfully, your obedient servant,

WM. L. HODGE,
Acting Secretary of the Treasury.

Com. WM. BRANFORD SHUBRICK,
President, Light-house Board.

CLASSIFICATION.

1. There is no formal classification of the lights, as any such arrangement would be practically useless; for, as there are no two lights built in precisely the same circumstances, and for precisely the same purposes, it is obvious that a perfect classification would embrace as many classes as there are lights.

2. Answer included in the above.

3. Although no formal classifications of the lights are made, yet the heights of the towers and intensities of the lighting apparatus are determined upon after a consideration of the geographical positions, and the requirements of navigation, the distance at which it is necessary to see the light, the extent of horizon to be illuminated, &c. The intensity of
the light is regulated by the number and size of the reflectors, which again regulate the size of the lantern, &c.

4. As there is no formal classification of the lights, I cannot give the number classed as first-order or class; but in what may be considered first-order lights, excepting the lens lights, the diameter of the burners is three-fourths of an inch, the diameter of the reflectors twenty-one inches. The number of reflectors and lamps depends upon the extent of horizon to be illuminated, and the required range or portee of the light. For the entire horizon, twenty-four reflectors would be required for a portee of twenty miles and over, which allows a divergence of fifteen degrees for each. In the actual state of things, however, this divergence is found to be considerably greater; therefore, for a less portee than twenty miles, fewer reflectors than twenty-four are used proportionally. For the various arcs of the horizon, the number is proportional to the angle of the arc.

5. A list of the light-houses will be herewith enclosed.

DISTINGUISHING CHARACTERISTICS.

1. The modes of distinction are: fixed white lights; revolving white lights; fixed red lights; revolving white and red lights alternately; double fixed lights; triple fixed lights, (one only;) fixed and revolving white lights, (double;) two lights in one tower, one above the other.

2. The answer will be found in the list of lights herewith enclosed.

3. The result of experience has shown that the only modes of distinction for first-class lights are fixed white and revolving white. These are the most efficient and cheapest, and are employed whenever it is possible to do so without risk of confusion. Single, double, and triple fixed lights, two fixed lights in one tower, one above the other, &c., including all those enumerated in the question, are efficient within limited distances, such as for bay, river, and harbor lights, or special localities not requiring much portee. They are, of course, more expensive than the fixed or revolving light from a single lantern. With regard to a beam of partly red and partly white light, there is but the one at the Sankaty Head light on Nantucket island; the red beam, or half-beam, has only been added within the last few weeks, and I am not yet in possession of the result. The board will doubtless ascertain it for themselves, by a personal examination. "The means employed to accomplish it" are, halving a Fresnel lens in the line of the focal axis, and giving the upper and lower halves different inclinations, the beam from the lower half being colored by passage through a red medium.

5. Red is the only color used. The number will be ascertained from the list herewith enclosed.

6. The colored lights are produced sometimes by colored tubes, sometimes by colored shades. The latter are preferable economically, from the great number of tubes broken; the former arrangement has a slightly less absorption of light, by the absence of the thickness of the transparent tube-glass. As these are, however, very thin and very clear, the difference of light cannot be considered sensible.

7. It is impossible to prevent absorption of light when colored media are used. In these cases, the color is made of as light a tint as possible
and yet be plainly distinguishable. The use of colored lights is, however, highly objectionable, not only on account of the loss of light by absorption, but from the fact that colors cannot be distinguished but at slight distances, and then only in clear states of the atmosphere. Colors are not a reliable mode of distinction, and are only adopted for cases where they are absolutely necessary.

POSITIONS OF LIGHT-HOUSES AND LIGHT-VESSELS.

The questions under this head will be found so fully answered in my communication of June 7, 1851, to the Secretary of the Treasury, transmitted to the board, that a restatement here is unnecessary. The board is respectfully referred to that communication.

ILLUMINATION, &c.

1. The answer to this question will be fully found in the communication above referred to, to which I respectfully direct the board.

2. There are three lens or Fresnel lights in the United States; two of them at the Highlands of Navesink, New Jersey, and one at Sankaty Head, Island of Nantucket, Massachusetts. Those at Navesink are of the first and second order fixed and revolving. That at Sankaty Head is of the second order revolving. The Navesink lights have one keeper and four assistant keepers. The Sankaty Head light has one keeper and two assistant keepers.

3, 4, and 5. The answers to these questions will be found fully in my communication of June 7, above referred to.

6. The hydraulic or pneumatic lamps have not been introduced, nor am I aware of any objection to their use, further than that I believe the supply of oil furnished to the wick not to be in sufficiently large quantities to insure as intense a light, with safety to the burners, as with the Carcel lamp.

7. Answered in my communication of June 7, above referred to.

8. The first half of this question will be found answered in my communication of June 7. With regard to the last half, if by "leading marks" ranging lights are meant, I would state, the only ones are the double lights at Newburyport, Massachusetts, and North Point, Maryland.

9. The answer to this question will be found specifically in my communication of June 7, to which the board are again respectfully directed.

10. There are no reflectors in use of an inferior quality, to my knowledge.

11. The reflectors are formed upon dies made of the perfect form, which dies were first tested as to their truth of form, by mathematicians employed by me for that purpose. In regard to this, the board are referred to my communication of June 7 for further information.

12. The lamps in use for the reflector lights are the fountain Argand lamps, with 2-inch diameter burner, made of iron, not tipped with silver, which is the means employed to secure durability. An experiment was made with burners tipped with silver, and found not to answer.
13. The answer to this question will be found in my communication of June 7, to which the board is respectfully referred.

14. The reflectors are placed either vertically or slightly differing towards the horizon, depending upon their elevation; the greater the elevation, the greater the dip.

15. Please see my communication of June 7.

16. For answer to the first part of the question, please see my communication of June 7. The length of time for which the reflectors will last, and transmit their light without unusual loss by deterioration is so very various, that it is impossible to give a general answer, as all depends upon the care and intelligence of the keepers. They will last from twenty-five to ten years, according to their proper use or abuse. The lamps and reflectors are attached to the chandeliers by rings and solid yokes, made to the proper dimensions for perfect adjustment with screws, &c., and provided with catches or slots to prevent the keeper from losing the adjustment.

17. I know of no such pattern as Alan Stevenson’s. Our 21-inch reflectors are made with a large focal distance and great depth; but whether they are precisely similar to Mr. Stevenson’s I am unable to say, further than that I know ours, and I believe Mr. Stevenson’s, to be true parabolias.

The illuminating apparatus used on our light-vessels is the compass lamp. No Argand burners and lamps are used. It is simply a reservoir to hold the oil, with a number of wicks placed around the circumference, the whole swung in gimbals, and hoisted up and down, (when placed in the lantern,) a pair of shears in the vessel, with counter weights.

18. The expense of repairs for the lamps alone has not been kept separate.

19. For the lights on the Atlantic coast, the average consumption of oil per lamp is thirty-five gallons per annum; the lamp is kept burning from sunset to sunrise. For further information please see my communication of June 7.

SUPPLIES, &c.

1. This question is fully answered in my communication of June 7, to which the board are respectfully referred.

2. The painting, whitewashing, repairs, &c., are done annually under instruction from this office, by contract to the lowest bidder, the local superintendent of lights, or some qualified person employed by him or myself, making previously the necessary examinations and specifications, estimates, &c.

3. Bells are employed in foggy weather.

4. Such as can be rendered by the keeper, and in his judgment are prudent to attempt.

5. The oil, &c., is kept sometimes in the towers, and on the northern coasts more generally in the cellars of the houses. The towers have no special oil cellars, the cellars of the dwelling-houses being large, and used for that purpose when the climate makes it necessary.

The oil is kept at a sufficiently equable temperature, either in cellars
or in the towers, by stoves in the lanterns, when made necessary by great variations of weather. The tanks in which the oil is kept are tinned iron, painted thoroughly. This is considered the most economical method of keeping the oil, and losses from leaks rarely occur. When they do occur, it is generally from carelessness in the keepers.

LANTERNS, GLAZING, &c.

1. The lanterns are constructed of wrought-iron angle posts, sashes, &c., with copper domes.

2. The difference of first cost between iron and bronze lanterns would probably be, taking the iron ones at 1, 2.25.

3. There is no advantage in the use of bronze for lanterns; it may be urged they are more durable from their not corroding; but when it is considered that the lower ends of the iron posts are leaded or brimstoned into the capping, and all the rest of the surface kept well painted, it will be perceived that there can be no greater durability. This involves the question of repair likewise: if there be no corrosion, there will be no repairs required, and the cost of painting is too trifling to enter as an element in the comparison "finally." With regard to lightness, the advantage is on the side of wrought-iron, which in similar and equal pieces is stiffer than bronze; consequently, to bear a cross strain, which is the only one the lantern posts suffer, greater thickness is required with bronze, by which more light is shut out.

4. French plate-glass is used of all sizes, from 16 by 28 inches up to 5 feet by 2½ feet, according to size of lantern, description of lighting apparatus, &c. Many of the very old lanterns are glazed with common glass. These, as fast as my means permit, are being removed, and improved lanterns substituted.

5. The size of the sashes or astragals varies with dimensions of lantern. The angle posts range from one and a half to one inch broad generally, with the exception of the very old lanterns, when they are sometimes two inches. The sashes average from one-half to three-quarters of an inch broad.

6. The astragals are all horizontal. The small glass is put in by putty, the large by pins; the very largest by sash-bars and top-screws. The lanterns are kept painted on the interior, sometimes black and generally white. They are painted under the direction of the local superintendent, whenever he considers they need it. Spare glass, &c. kept on hand to repair broken panes. The system of ventilation in general use is by a top ventilator traversing of various forms, or Collins’s patent, and by side ventilators, in the base of the lanterns, or in the lantern doors: but these means are very inferior to what is furnished by the scuttle door being left open, which, using the whole height of the tower for chimney, gives a powerful draught, of such efficiency as cannot be obtained by any other arrangement; and this is resorted to even where the lantern bases are well supplied with small ventilators.

Professor Faraday’s ventilating tubes are not used, as the open scuttle supplies a power of draught and a quantity of air sufficient for perfect combustion without them.
ATTENDANCE UPON THE LIGHTS, &c., TO SECURE EFFICIENCY, CERTAINTY, AND CLEARNESS.

The keepers are appointed by the Secretary of the Treasury—one to each light, with the exception of the Navesink and Sankaty Head lights, at the north, and those lights at the south specified in the manuscript catalogue. The Navesink light has one keeper and four assistants; the Sankaty Head light, one keeper and two assistants; these being lens lights. The assistants are appointed by the keepers, with the sanction of the local superintendent. The southern lights having assistants, have but one assistant each. The keepers are not instructed previously to entering upon their duties, the trimming and cleaning of a small Argand fountain lamp being so simple and self-evident as to be left to the intelligence of the meanest capacity. Keepers are supplied with printed instructions, to guide them in the performance of their duties, copies of which instructions I have sent the board.

The towers are painted or whitewashed, by order of the same persons and in the same manner as the repairs are attended to. The general distinguishing mark of the towers, by day, is their colors. They are either whitewashed, which is the general case, or have a red stripe horizontally between two white ones, as at Sankaty Head light; or they are partly dark brown and partly light, one color above the other, as at Cape Hatteras light; or by the dark granite color of the stone, as at Saddleback Ledge, Monheigan lights, and others. Others are distinguished by the number of the towers, as two, or three. The number of these will be obtained from the accompanying catalogue. Alarm signals are made in foggy weather, by bells rung by machinery. The number of localities fitted with bells will be found in the accompanying catalogue.

CONSTRUCTION.

1. There is not what may be called any general system of construction, though there are generally adopted four sizes of towers; each locality has had a particular plan and specification made for it.

2. To give the modes or plans employed, would involve sending copies of the contracts, specifications, and working-drawings of over three hundred light-houses; a labor which it is entirely out of my power to perform with the means of my office. Most of the specifications and working-drawings were used up by the workmen; and as they were merely ordinary arrangements of work suited to special cases, they had no further value, and were not preserved. To give copies of these trivialities would be impossible, and useless if possible.

3. The kind of tower, if for difficult locations, is sometimes made at this office, sometimes by experienced engineers employed by me for that purpose, and in all cases examined and approved by me.

4. All work done for this office is done by contract by the lowest bidder at a public letting. The contracts embrace the entire work generally, excepting in particular cases, where the lighting apparatus is furnished by a separate contract; where it is not, the contractor for the whole work is bound to obtain the lighting apparatus from the manufacturer designated, at a certain price, according to a previous contract.
with this office. This is to insure the proper kind of lamps and reflectors. I know of no objection to this system and its advantage over the "day-labor" system is found in its greater economy. A regular superintendent is employed to oversee the direction of the work day by day, inspect materials, &c. He is either an experienced mechanic or engineer, as the case may require, and no money is paid without his certificate that the work is faithfully executed according to contract.

5. Conductors are attached to light-houses, by the ordinary means familiar to all.

6. As many different means are employed to restore impaired foundations as there are foundations so impaired, varying with the circumstances and the resources of the mechanics and engineers employed for the purpose.

The board will perceive the absurdity of requiring general answers to cases which vary with every variation of locality, and that, too, upon mere points of constructive detail, involving nothing greater than the particular plan of shoring up a house, or underpinning a tower, in which all that is required is a small knowledge of ordinary mechanical means, such as is in the possession of every master workman or engineer. The only general answer I can give is, that each problem has its particular solution. These repairs are contracted for and superintended in the same manner as the construction; their necessity is ascertained by surveys, made by the local superintendents.

LIGHT-VESSELS, BUOYS, AND SEA-MARKS.

1. The light-vessels are procured by contract from the lowest bidder. Their models vary for the different positions they occupy. The internal arrangements, &c., will be found from the two enclosed specifications, one of a small class, the other of a large-class vessel. A light-vessel will last, according to latitude and timber, from five to ten years. The average annual repairs are very great, and are so included in the cost of maintenance as to be difficult of separation. The greatest number of men employed on them is, for the most exposed stations, ten; for the least exposed four men; and for other stations in proportion. The pay of the crew is regulated by the pay of sailors from the nearest port. In addition to their pay, each man is allowed one ration per day. The pay of the captain on sea-stations is $700 per annum; on bay and sound-stations, $500 per annum. For further information and more detailed, please refer to the manuscript book I have already sent to the board.

2. The light-vessels are not removed unless they need repairs. There is only one relief-vessel, which is kept at Norfolk, Va. They are kept the entire year at their moorings, excepting the one at Stratford point, Long Island sound, and the two in the Potomac river. These are removed in December and replaced in March.

3. The light-vessels are moored by pilots; the plan of mooring will be seen from the enclosed specifications.

4. The light-vessel moorings are examined by the captain from time to time, and are renewed when judged necessary, after examination by the local superintendent on report of the captain, or by some competent person employed by him for that purpose.
5. There is no system of relief for captains or crews.

6. The captains are required to live on board, and they cannot delegate their authority to others.

7. The captains of light-vessels are not required to have belonged to any particular profession; generally, captains from the merchant service are employed. The same system for inspection and repair provides for light-vessels as for light-houses. When repairs are needed, and reports made, their communications are sent by the captains to the local superintendents.

8. The printed instructions to masters of light-vessels have already been furnished.

9. The same means are employed to ascertain the proper positions of buoys, beacons, and sea-marks, as for ascertaining the proper positions of light-houses, as already detailed.

10. The buoys are placed by contract with pilots; they are taken up and replaced in the same manner, by orders from this office.

11. The buoys are distinguished according to the act of Congress, approved September 28, 1850, to which I respectfully refer the board.

12. When buoys have been carried away, the fact is ascertained by report of masters of vessels and pilots. They are immediately replaced by the local superintendent.

13. No buoy can be placed, except by act of Congress. There are, then, no casualty buoys. A catalogue of the different buoys will accompany this communication. The contractor is constantly going round to ascertain if the buoys be in their proper positions.


15. They are only raised where immediate danger is apprehended from ice, freshets, &c., and then by the contractor. They are replaced the moment the danger is passed.

16. The expenditure with the buoyage is regulated in the same manner as for the light-houses.

17. There are but two tenders—one in Delaware bay, hired; and one at New York, belonging to the light-house establishment. The expense of the New York tender for the year 1849 was $3,250. The Delaware tender is hired by contract from the lowest bidder; the present price is $995 per annum.

MISCELLANEOUS.

1. Notices are given to mariners by advertisements in the public papers of extensive commercial circulation. The notices are from one to two months previous to the lighting or changing of any light, &c.

2. There are but two inspectors employed in addition to the local superintendents, one upon the northern lakes and one at New York.

3. None other than the keepers are employed permanently in connection with the gas-lights. The number of gas-lights, and such other information as I have to communicate, will be found in my communication to the board of the 7th June, 1851.

4. For the number of light-house districts, &c., please see the manuscript book already referred to, as sent by me to the board.
5. Two-and-a-half per cent. is the commission allowed upon the expenditures.

6. The manner in which inspections of lights are made by the local superintendents, &c., has already been given in the preceding; the results are reported to this office for approval, necessary instructions, &c.

7. All the information relative to the employment of gas, &c., in the possession of this office, has already been given in the various communications made to the board, nor am I aware of being in the possession of anything more to add.

---

TREASURY DEPARTMENT.

Fifth Auditor's Office, July 7, 1851.

SIR: In making up the answer to the questions propounded by the Light-house Board, it was omitted to notice that in respect to obtaining the supplies of oil annually. I now supply that omission by sending a copy of the printed advertisement for the year, of the several bids received in pursuance of it, and of the contracts entered into with the party. The same course is taken twice in each year—once with respect to the northern lights, early in the year, and once in respect to the southern lights, the latter part of the year.

I have the honor to be, sir, very respectfully, your obedient servant,

S. PLEASONTON.

To Wm. L. Hodge, Esq.,

Acting Secretary of the Treasury.

---

TREASURY DEPARTMENT, July 8, 1851.

SIR: I enclose herewith a letter from the Fifth Auditor, of the 7th instant, with sundry papers, intended to show the manner of supplying the light-houses with oil.

Very respectfully, your obedient servant.

WM. L. HODGE,

Acting Secretary of the Treasury.

Com. Wm. Branford Shubrick,

President Light-house Board, now at Boston.

---

TREASURY DEPARTMENT,

Fifth Auditor's Office, April 2, 1851.

SIR: In reply to your note of the 1st instant, requesting me to furnish Professor Bache with some such papers as may be in this office, giving information as to the necessity and importance of constructing light-houses and light-boats for which appropriations were made by the light-house law of the 3d March last, I have to state that, with three exceptions
which I shall state, I have no knowledge of the reasons on which the several appropriations were made. The Committee on Commerce of the House of Representatives reported the bill, which was not printed, the last night of the session; I had no knowledge of it until it passed into a law. It is presumed the committee made the appropriation upon the application of individuals of whom I have no knowledge; hence I can give Professor Bache no information that would aid him, or the officers under him, in forming an opinion as to the expediency, or otherwise, of building the light-houses, light-boats, buoys, &c., for which appropriations are made. The necessity for the examination is apparent, however, from the many lights on the coast and lakes, and the fact that on some parts of the coast the lights are now so numerous that it is impossible to distinguish one from another, and they are hence becoming a nuisance.

The exceptions referred to above are the three additional appropriations recommended by this office, viz: for the light-house on Horseshoe reef, Niagara river, twenty-five thousand dollars; for a light-house on Bodkin shoal, mouth of the Patapsco, (Seven-foot knoll,) seventeen thousand dollars; for a light-house at the upper Jettee, Cape Fear river, including a bridge from the shore to the light-house, thirteen thousand dollars.

These are works which it has been determined to prosecute, and need not therefore be examined.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

WILLIAM L. HODGE, Esq.,
Acting Secretary of the Treasury.

TREASURY DEPARTMENT,
Fifth Auditor's Office, April 3, 1851.

SIR: In answer to your note of the 2d instant, just received, I have the honor to inform you that no steps have been taken by me for building any of the light-houses or light-vessels for which appropriations were made on the 3d March last; considering it necessary that the several sites should be previously re-examined and reported upon by the officer to be appointed for the purpose.

And with respect to the three which it had been previously determined to build, and for which additional appropriations were necessary, and were made by that act, I was prevented from taking any steps towards building them by a clause in the act requiring the President to cause to be detailed two engineers of the Army for the purpose of superintending the construction and renovation of light-houses.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

WILLIAM L. HODGE,
Acting Secretary of the Treasury.
Bodkin Point or Seven-foot Knoll light-house, mouth of the Patapsco, Chesapeake bay.

OFFICE LIGHT-HOUSE BOARD,
October 10, 1851.

SIR: I have the honor to submit, herewith, plans, drawings, and specifications for a light-house on "Seven-foot knoll," in the Patapsco river, which have been carefully prepared by the Committee on Construction of Light-houses, and examined and approved by the board.

Very respectfully, your obedient servant,
WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury.

WASHINGTON CITY, October 10, 1850.

SIR: The committee to whom was referred the resolution of the board of July 26, respecting a screw-pile light-house for "Seven-foot knoll," at the mouth of the Patapsco river, respectfully report the drawings herewith, marked A, B and C, containing the plans, sections, and elevation of a structure for that locality, as also a description of the same, marked D.

JOS. G. TOTTEN,
Brevet Brig. Gen'l and Col. of Engineers.
JAMES KEARNEY,
Lieut. Colonel, Topographical Engineers.

Report on the Seven-foot Knoll light-house.

The committee to whom was referred the subject of the proposed light-house on the Seven-foot knoll, off Bodkin point, mouth of the Patapsco, respectfully report the following considerations:

That a screw-pile light-house, on the same principle as that erected at the Brandywine shoal, be adopted for the position in question.

That an estimate, with drawings, be prepared accordingly, to be submitted for the consideration of the board, and being by them amended, if necessary, be submitted for the sanction of the Secretary of the Treasury.

That on the plans and estimates thus sanctioned, proposals be called for in the public newspapers for the erection, under contract, of the light-house and ice-breaker.

That in the acceptance of any such proposals by the Treasury Department, the execution of the work be put under the immediate and constant supervision of some competent engineer.

That the height of the light-house above high-water mark should be forty feet.
That the light should be of the third order of French lenses, whether fixed or revolving to be determined hereafter.
Respectfully submitted.

JOS. G. TOTTEN,
Brevet Brig. Gen'l and Col. of Engineers.
JAMES KEARNEY,
Lieut. Colonel, Topographical Engineers.

Adopted.

TREASURY DEPARTMENT, October 13, 1851.

SIR: I transmit, herewith, the plan and specifications, by J. W. P. Lewis, for a light-house at the Seven-foot knoll, Patapsco river, which the party offers to construct for the amount of the appropriation.
The party presenting this plan states that it shall be, in all respects, similar to the one recommended by the Light-house Board, and executed agreeably thereto, except that it has a broader foundation, has not the third story, and the two actual stories are of wood, on an iron framework, instead of being entirely of iron, as in the plan submitted by the board.

As the season is rapidly passing, the Department would be pleased to have the opinion of your board upon the above modifications, provided that, in all other respects, the plan already submitted by the board should be carried into effect.

Very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Com. W. B. SHUBRICK,
President Light-house Board, Washington.

REPORT.

OFFICE LIGHT-HOUSE BOARD,
October 13, 1851.

The committee to whom was referred the letter of the Assistant Secretary of the Treasury of this date, (October 13,) submitting to the board Mr. Lewis’s plan, sections, and specifications of a light-house for the entrance of the Patapsco, have given them the hasty examination which the time allowed would permit, and have, respectfully, to report:

That they do not now see any irreparable defect in that plan which contemplates a wooden superstructure, and do not, therefore, object to it as a temporary work; but seeing that the Bodkin light is to be suppressed on the completion of the Seven-foot Knoll light—and therefore the work is to be viewed not merely as a local accommodation to the bay craft and coasters, but as the principal guide to the foreign shipping of
the port of Baltimore—we cannot recommend it, believing that, in a position of so much importance, only a permanent light will fulfil the essential conditions.

Respectfully submitted.

Jos. G. TOTTEN,
Brevet Brigadier General and Colonel of Engineers.

James KEARNEY,
Lieutenant Colonel, Topographical Engineers.

Adopted.

Office Light-house Board,
October 13, 1851.

Sir: I submit, herewith, an estimate for the screw-pile light-house, recommended by this board for the "Seven-foot Knoll," which is intended to accompany the plans and drawings submitted with my letter of the 10th instant.

Very respectfully, your obedient servant,
WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury.

Office Light-house Board,
January 15, 1851.

Sir: I am directed by this board to communicate to the Department the result of their investigations in relation to the erection of a light-house on Flynn's knoll, in New York bay, agreeably to your instructions

FLYNN'S KNOLL, NEW YORK HARBOR, &c.

The board, in a communication to the Department, in July last, stated that they had great doubts as to the propriety of commencing this structure; since that time they have collected additional information, by which they have been enabled to arrive at the following conclusions:

1. That there is no necessity for erecting a light-house on Flynn’s knoll, in New York bay.

2. That to do so would involve the risk of serious injury to the channels and bars.

3. That by a judicious system of range lights, all the facilities necessary for ingress and egress of vessels, navigating by day or by night, would be afforded.

The board therefore respectfully recommend that authority be asked of Congress to apply the appropriation for Flynn’s Knoll light-house to the erection of four small range lights, two of them to be placed on or near the line LM, and two on or near the line FS, as designated on
the coast-survey chart of New York bay, to serve for the main channel around southwest spit, and through the swash channel to the eastward of Flynn's knoll.

The board further recommend an appropriation for a bell buoy to be placed on or near Flynn's knoll.

The board, not having the means at their command for making the necessary surveys of the sites for these proposed range lights, are indebted to Professor Bache, superintendent of the Coast Survey, for all the detailed information on this part of the subject, and concur with him in recommending that beacons be located on or as near these points designated on the chart as may be found to be practicable.

The board recommend that should Congress authorize these range lights to be erected, a competent engineer officer be detailed for erecting the structures, to be furnished by the superintendent of the Coast Survey with such surveys as may be required.

In the opinion of the board, one-third and three-fourth order lenses will be required for these light-house towers, which should have a sufficient elevation to give the requisite ranges of twelve to nine miles.

In connection with this subject, they consider it their duty to call the attention of the Department to the subject of buoys, in this and other principal bays and harbors, with reference especially to the law of 1850, on the subject of coloring and marking buoys.

The channel into New York bay, discovered and surveyed by the officers of the Coast Survey, and known as "Gedney's channel," requires to be better marked than at present, to enable pilots and others to avail themselves of the greater depth of water.

All of which is very respectfully submitted.

WM. BRANFORD SHUBRICK,
President Light-house Board.

HON. THOMAS CORWIN,
Secretary of the Treasury.

Report of Flynn's Knoll Light-house.

OFFICE LIGHT-HOUSE BOARD,
October 9, 1851.

The committee to whom was referred the subject of a light-house on Flynn's knoll, after visiting that locality, and carefully considering all the information on the subject collected by the board, are of opinion:

That the placing of a light-house of any kind on Flynn's knoll is a matter of so much importance, in view of the effect that it may have on the channel, and the necessity for a light there at all as an aid to navigation, has given rise to so much diversity of opinion among pilots, insurance companies, and others interested in commerce, that they cannot now advise any structure to be placed on the knoll, but recommend a large bell buoy or floating beacon to be placed at such point as will best serve to indicate the position of the shoal.
The committee make this recommendation, because they are unwilling to advise any step which experience may prove not to be the most judicious; and further examinations may afford safer grounds than they at present possess for coming to a decision.

Respectfully submitted.

J. G. TOTTEN,
Brevet Brig. General and Col. of Engineers.

JAMES KEARNEY,
Lieut. Colonel, Topographical Engineers.

Adopted.

OFFICE LIGHT-HOUSE BOARD,
Washington City, June 13, 1851.

SIR: The Light-house Board, in compliance with the request contained in your letter of the 28th ultimo, proceeded to New York, and on the 3d instant visited the locality indicated by previous surveys for a light-house on Flynn's knoll.

The importance of affording to the commerce of New York every facility of ingress and egress—the great hazard to which valuable property, and still more valuable lives might be exposed, if any means should be neglected which would enable the mariner to find, with the greatest possible certainty, the wished-for haven—caused the board to approach the subject of this light-house with an anxiety to make just and proper conclusions which it need not express.

Information which might assist the board in its judgment was sought for from all reliable sources within its reach. Some it has obtained; of more it is yet in expectation. With such aids, with its personal examination, and with the excellent coast-survey chart of the harbor before it, the board feels no hesitation in expressing the following opinions:

1. That the necessity for a light-house on Flynn's knoll is, to say the least, not so urgent as to require immediate action under the law of March 3, 1851.

2. That it is probable that the advantages to be expected from a light-house on Flynn's knoll may be in a measure obtained by ranging lights on the New Jersey and Staten Island shores, not to exceed four in number.

3. That even if it should be found that a light on Flynn's knoll is necessary, the question as to the kind of structure most proper for that position is one the decision of which requires more information than the board has yet been able to obtain.

Independent of all considerations of expense, the erection of a stone structure (always the best when the position will admit of it) would involve hazards to the channel by interrupting the natural course of the waters, the consequences of which cannot be foreseen, and which greatly outweigh any benefits that could possibly be expected from the light.

Two other modes of obtaining foundations for light-houses on sand shoals have come under the notice of the board—one by means of solid screw piles, worked into the sand by mechanical power; and the other
by means of hollow cylinders of hard metal, driven deep into the sand by the pressure of the atmosphere, and filled either with masonry or concrete. It has been stated, in an examination had before a committee of the House of Commons, in 1850, that a cylinder was sunk sixty-five feet by this process, in the Goodwin sands.

This method, which is of recent invention, claims to possess advantages over the others that are worthy of attention; but the board desire to have time to make further inquiries in relation to it.

The patentee of this invention for the United States has a contract for the construction of a wharf at Cape May, in an exposed situation, and has informed the board that he should be at work there, he thought, by the 15th of July next. This will afford an opportunity to witness the process in operation, of which it is the desire of the board to avail itself.

On the 10th instant the board visited the Bodkin shoal, (Seven-foot knoll,) on the subject of which a special report will be made after the examination of the Brandywine Shoal light, which is on screw piles, and the operation of the pneumatic-pile wharf at Cape May.

Very respectfully, your obedient servant,

WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Thomas Corwin,
Secretary of the Treasury.

COAST SURVEY OFFICE,
November 29, 1851.

SIR: An examination made of Flynn's knoll, New York harbor, with the members of the Light-house Board, induced a doubt in my mind whether the light-house Board proposed to be erected there was the best aid to navigation which could be suggested, and, indeed, whether it might not alter, injuriously, the present régime of the harbor. The inquiries of the Light-house Board were directed to the same points, and their conclusions will, therefore, also be before the Department.

It occurred to me that a system of range beacons could be used for passing Sandy Hook by the main ship channel, and for passing through the swash channel, which would answer all the purpose of the proposed light on Flynn's knoll, without being attended with any risk of causing new deposits on the bar, and which could be put up and maintained at a very small expense. I have accordingly caused minute surveys to be made of the shore near the probable sites of these beacons, and transmit, herewith, the sketches and report returned by assistant J. B. Glück, of the coast survey; and also a coast-survey chart of New York bay and harbor, marking these and other sites on which range lights may be established to answer the purpose referred to above.

I would recommend two range lights, (beacon,) to lead from the point G, in Gedney's channel, through the main ship channel to the range of the beacons already recommended in the sailing line H N, through the narrows; the beacons to be on the line G B or G M, or in the angle be-
tween them, as may be found most expedient on an examination, which should be made just previous to their location. The distance A D is rather small for the range, being less than one-ninth of G A. A beacon near L will furnish, also, important ranges.

Also two leading lights, (beacon lights for the swash channel,) nearly on the line S E. Before placing these lights the swash channel should be carefully resurveyed, which can be done at a very trifling expense by the coast survey, by using existing marks on the shore already determined in the survey, as there is an impression among the pilots that it is deepening. The beacons should be placed accordingly.

These lights should be so arranged that they will appear nearly in one, when heading on the sailing lines. They should be distant from each other not less than about one mile and a half, or one-sixth of the distance from which they are first required to give the range. They should be carefully screened, so as only to show a light on the range or ranges which they are to indicate; and for distinction from each other, as they are only required to show some nine miles, the one near the Elm-tree beacon may be a red light, (deep red.)

Yours, respectfully,

A. D. BACHE,
Superintendent United States Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

TREASURY DEPARTMENT, May 28, 1851.

SIR: By the act of 3d March last, thirty thousand dollars are appropriated for a light-house on Flynn’s knoll, near Sandy Hook, N. Y., and seventeen thousand dollars, in addition to a previous appropriation, for a light-house on the Bodkin shoal, (otherwise called Seven-foot knoll,) mouth of Patapsco river, Maryland.

Desiring to avail myself of the professional knowledge and experience of the Light-house Board, as to the proper kind of structure to be placed at these several points, I have to request that the localities thus indicated may be visited and examined by the board, or by at least two of its members, with a view to that object, and that the opinion of the board, found from such examination, may be reported to the Department with an estimate of the cost of the structures so recommended.

The revenue cutters employed on the Norfolk and New York stations, or the steamers on coast-survey duty, may be used in the performance of this service, as may be found most convenient.

Very respectfully, your obedient servant,

THOMAS CORWIN,
Secretary of the Treasury.

Commodore WM. BRANFORD SHUBRICK,
President of the Light-house Board, Washington.
TREASURY DEPARTMENT, May 29, 1851.

SIR: I transmit you herewith a copy of a letter addressed to the collector of New York, requesting him to furnish all the information in his power to any members of the Light-house Board respecting the light-houses connected with that harbor, and to place the revenue cutter at their disposal, for visiting the different points which they may desire.

In case circumstances shall not admit of the cutter being employed on the above service, you are authorized to employ some other suitable vessel or steamboat for the purpose, on reasonable terms.

Very respectfully, your obedient servant,

THOMAS CORWIN,
Secretary of the Treasury.

Commodore W. B. Shubrick, Washington.

OFFICE OF LIGHT-HOUSE BOARD,
Washington City, June 11, 1851.

SIR: I am directed by the Light-house Board to ask of you the favor to communicate, at your earliest convenience, any information which may be at your command in relation to improvements in lights and other aids to navigation in the vicinity of New York bay, and the approaches to it.

The board would respectfully call attention to the following points:

Is there any necessity for a light-house on Flynn's knoll?

Would a system of ranges on the Jersey and Staten Island shores obviate the necessity for placing a light-house on Flynn's knoll?

Have vessels, and how many, been wrecked and suffered for want of a light on Flynn's knoll within a specified number of years?

Have vessels been prevented from running in for want of a light on Flynn's knoll?

What particular advantage is to be gained by placing a light on Flynn's knoll?

What is the condition of the buoys and dumb beacons?

Are the buoys of proper dimensions, shape, and color?

Are there a sufficient number of buoys and dumb beacons?

Is the light-vessel near Sandy Hook properly placed, and if not, what position is proposed?

What reasons for wishing the position of the boat retained or changed?

As the board is anxious to make a report, which it cannot do until it is in possession of all the reliable information upon the subject which it can obtain, it requests as early a reply to this communication as may be practicable.

I am, sir, very respectfully, your obedient servant,

THORNTON A. JENKINS,
Lieutenant U. S. Navy, Secretary to Light-house Board.

To the President
Of the Board of Pilots and others, New York.
NEW YORK, June 14, 1851.

SIR: Your favor of the 11th came to hand, and in answer to the inquiries relating to the light-boats, beacons, &c., in the vicinity of New York bay and the approaches to it, I will endeavor to state my views as far as my knowledge and experience go.

In the first place, you ask is there any necessity for a light-house on Fynn’s knoll?

I think not. Ranges on Jersey and Staten Island would answer much better.

In the second place, you ask how many vessels have been wrecked and suffered for want of a light there, and how many have been prevented from running in for want of a light there within a number of years.

I am not aware of any. Vessels do frequently get on there in thick weather in day time; very seldom in night time, for in clear weather there are plenty of ranges, night or day, to be seen, with a good pilot on board, to keep vessels from getting on there. Large vessels seldom come in at night, unless the weather is clear.

In the third place, you ask what particular advantage is to be gained by placing a light there?

I think it far better as it is, without any light on the knoll; as the lights on Sandy Hook are so very near the knoll, they would appear as very near together a little distance off. A dumb beacon put there would answer, I think, far better than a light.

In the fourth place, you ask what is the condition of the buoys and dumb beacons, and are the buoys of proper shape and color?

The dumb beacon, I think, is of a proper size and color. The buoys are small—color very well as they are.

In the fifth place you ask, is the light-boat off the Hook properly placed; if not, what position is proposed?

The boat cannot be put in a better position than where she now is. Should she be taken from there, many vessels would be lost in the neighborhood of Sandy Hook; whereas now, when they make the light-boat, they can shape their course for the Hook, let the weather be ever so thick, and get in safe. But was no boat there, and thick weather, and a vessel getting close in and nothing of the Hook to be seen, and the wind from southeast, she could not possibly haul off, but would go ashore. In 1847 I was coming home from Cadiz, in the ship Thomas Dickinson; it was blowing heavy and very thick; we made the light-boat and found our way in; but had there been no light-boat there, we could not possibly have got off clear. The vessel must have gone ashore unless cables and anchors had held her.

In the sixth place, you ask what reasons for having the boat’s position retained or changed?

I cannot see any reasons for removing the boat from her present position.

Respectfully, your obedient servant,

ELBERT LATHAM, Captain.

THORNTON A. JENKINS, Esq.,

Lieutenant U. S. Navy, and Secretary to Light-house Board.
LIGH-TOUSE PAPERS.

Office of the Board of Underwriters,
New York, June 14, 1851.

SIR: Yours of the 11th is received. I shall be obliged to obtain part
of the information you desire from practical men engaged in passing in
and out of Sandy Hook.

I now send you a communication signed by about twenty shipmasters,
requesting that the light-ship may be kept in her present situation, and
that she may be furnished with a gun.

I will furnish you with additional matter as it comes in my possession,
which may take sometime to procure.

Very respectfully, your obedient servant,

WALTER R. JONES, President.

To Lieut. Thornton A. Jenkins,
Secretary of the Light-house Board.

---

Port Warden's Office,
New York, June 17, 1851.

SIR: In compliance with the directions of the Light-house Board, asking
for any information which may be at my command, in relation to
improvements in lights and other aids to navigation, in the vicinity of New
York and the approaches to it, I herewith send you my answers to the
following questions, viz:

Is there any necessity for a light-house on Flynn's knoll? In reply
I would say, no.

Would a system of ranges on the Jersey and Staten Island shores
obviate the necessity for placing a light-house on Flynn's knoll? A
system of ranges on Jersey and Staten Island shores would be far more
beneficial to the navigation than a light on Flynn's knoll.

Have vessels, and how many, been wrecked and suffered for want of a
light on Flynn's knoll, within a specific number of years? I have only
known some two or three vessels to have been wrecked on this shoal
since 1818.

Have vessels been prevented from running in for want of a light on
Flynn's knoll? I should say not, so far as relates to vessels having
pilots on board.

What particular advantage is to be gained by placing a light on
Flynn's knoll? A light on Flynn's knoll would designate, of a clear
night, the starboard or north side of the channel, to vessels bound in;
but in hazy weather it would be liable to be confounded with the Hook
lights.

What is the condition of the buoys and dumb beacons? The buoys
generally are in pretty good floating condition, and the dumb beacon on
Romer shoal is a solid and substantial structure.

Are the buoys of proper dimensions, shape, and color? A cone
placed on the head of the present can buoys would make them much
more conspicuous, for, in rolling, they would be more likely to attract
the eye. The color of the buoys has too much sameness to be depended
upon in rough weather by vessels passing quickly through the water, particularly in hazy weather.

Is there a sufficient number of buoys and dumb beacons at present? There is a sufficient complement of buoys when the usual number is laid down. I would not hesitate to say, that if a dumb beacon was placed on Romer shoal, on the southeast part, and also one on Flynn's knoll, near the edge of their respective channels, they would be important as guides in coming in, or going to sea.

Is the light-vessel near Sandy Hook properly placed; and if not, what position is proposed? In my judgment, I say that the light-vessel is properly placed for large-class ships and steamers.

What reasons for wishing the position of the boat retained or changed? My reasons for the ship's retaining her present position are, that she has proved to be an important guide in taking a departure from her to run for the bar. She is also useful to the largest class ships, to lay by her during the night, while waiting for an opportunity to run in. She is particularly serviceable to pilots, in aiding them as a mark to steer from, to run in for the bar. The only good reasons that I can give for a change would be in exchanging the vessel itself for a new one, as she is getting old. A new light-ship of greater length, and with all the modern improvements in model, lights, &c., would add much to the safety of commerce to and from this port; and, in conclusion, I would strongly urge the present light-ship station to be retained.

I am, with great respect, your obedient servant,

ROBERT T. NORRIS.

THORNTON A. JENKINS,

Lieutenant U. S. Navy, Secretary to Light-house Board.

NEW YORK, June 30, 1851.

SIR: I have received your note of inquiry respecting the light-houses, buoys, beacons, and light-boats within the vicinity of Sandy Hook and New York bay.

Without repeating here all the questions you ask me on the separate heads, and wishing to be as brief as possible in the premises, I will take them up in their order.

There is no necessity for a light on Flynn's knoll. I am too well satisfied, from long practical observation, that a light-house on that spot would be an injury rather than a benefit.

I think that if a light-house and beacon were placed on the Jersey shore, somewhere in the vicinity of Point Comfort, that they would be sure guides into the Hook, and serve also as marks, both by day and night, for Flynn's knoll; and I think also, when properly understood, after a short practice by pilots, (proper,) can be made a leading mark for the western entrance of Gedney's channel.

This channel, which has some peculiar advantages over the other two channels over the bar, is sadly in want of leading marks for its best water. A light-house or monument of sufficient height, should be built
somewhere in the vicinity of Princess Bay light, on the Staten Island shore, so as to make a leading mark for its E. SE. and W. NW. courses.

In consequence of a want of proper marks, and having little faith in the buoys remaining in their proper places, I am too well satisfied that there is more water in Gedney's channel (going around the bar) than there is over the bar, in either the old north or south channel. But, I ask, where is the use of a good channel, if there are not proper and permanent marks established for it? This is all that is wanted to make it understood, and to give security to the heaviest vessels (either war or merchant) known to us, (at a proper time.) The buoys in Gedney's channel are but poor affairs at the best; they do not show to much advantage. They should be topped three feet higher, and not so sharp at the foot of the buoy; and then, if they would float higher out of the water, would be of some real use to those who, like myself, have confidence in them, and who wish to establish for the port of New York that name which she is entitled to, as being first among the States of the Union.

You ask what is the condition of the buoys and the dumb beacons? The dumb beacon on Romer is in very good condition, as far as the structure is concerned, but it should be painted white, and then it could be seen further, particularly in the night, when it is much sought after by coasters, pilots, and all others navigating that bay.

As regards the buoys in the lower bay, I unhesitatingly say (and such also is the opinion of all shipmasters, coasters, pilots, and others navigating that bay whom I have spoken to on that subject) that they are miserable in the extreme, and have been so for many years; but they are now worse than ever they were before. The buoys that were formerly black are now red. These red* buoys cannot be distinguished in their color, even in the day time, without you are near enough to touch them; and at night it is utterly out of the question to tell whether it is a red or a black buoy you have made.

Much indeed might be said on this subject, as regards the size and colors of these buoys for day or night, and in thick weather; but I will only remark here, that if a pilot cannot see his landmarks, he cannot tell what buoy it is he sees; and when his marks can be seen, the buoys are (to pilots) of but little consequence.

I have always understood that buoys have been intended for thick or hazy weather, when landmarks cannot be seen accurately, and also for the use of those who do not know the private marks or ranges for the shoals which they are placed upon. If a buoy is made suddenly, in coming out of a fog, which is often the case, the colors are so nearly alike, even at short distances, that it is next to impossible to tell its color.

The buoys on the tail of the west bank, upper middle, western knolls, SW. spit, and the buoys on the bar, should all be made at least one-third larger; as they now stand, in color and size, they are mere apologies for buoys, as far as pointing out a shoal goes.

I would seriously recommend that a large bell buoy should be placed on Flynn's knoll, until those ranges can be built on the western shore,

* The red paint being bad, is the cause of this.
as a mark for the knoll, and for the western entrance of Gedney's channel. There is a large spar buoy placed on that shoal at this time; it is painted white, and it can be seen further than any other buoy in the bay. This is entirely owing to its strongly contrasting color on the water. This is the standard opinion among all pilots that I have conversed with, and also of all others who have seen it and compared it with the red buoys.

As regards the lights and beacons in and about the bay of Sandy Hook, as regards their strength, they may be termed from fair to middling; I have seen far better. The light lately erected on Sankaty Head, Nantucket, is by far the best light that I have ever seen in my cruising off and on our coasts. I see no reason why the lights on Sandy Hook cannot be made as good as that; and, sir, if a little more attention was paid to keeping the east beacon from going out as often as it does, and generally just before daylight, it would give greater satisfaction, and more security to all those who have to navigate that bay and the approaches to it. I hear many complaints from pilots on this subject. I do not wish to censure these light-house keepers, but if the fault lies in the lighting apparatus, it should be remedied as early as possible. This is saying the least I can of it, and the best too.

There should also be built a light-house and beacon on Staten island, on the ground known to pilots and others as the "four sand hills," for running through the swash channel in the night time, and particularly to steamers of light or moderate draught of water. These lights are much needed. There has been little or nothing done for commerce and navigation in the bay of New York and Sandy Hook, in the way of light-houses or permanent marks. Pilots and others have been mainly indebted to nature and accidental causes for their marks for shoals and channels.

There is a very prominent mark standing on Staten island, and known to pilots as the "old mud fort." This mark is highly useful in crossing the bar. From the improvements that are every day taking place, I am very well assured that it will share the fate of many others of like value, and a useful mark will be lost, for the best water over the bar, in the old south channel, and for the outer middle.

It is full time that this subject should be fully and clearly looked into. The General Government should appoint some of our best naval officers to this post, and a separate bureau should be placed under their control, having no connection with any other Department. Then, and not until then, will we have a proper and well regulated system of lights and buoys on our whole coast.

In relation to the light-boat off Sandy Hook, I unhesitatingly say, without any fear of successful contradiction, that she is in every respect properly placed, and could not be moored in any other spot, outside or inside of Sandy Hook, where she could give so much use and security to all vessels coming in and out of this port and the approaches to it.

The strength and height of her light could, I think, be improved. There should be another (a spare light-ship) always ready to take her place in case of any accident to her, or when she is obliged to come into port for repairs, &c. Her place should never be left unprovided.
I trust that your best efforts will be used to call the earliest attention of Congress to a general revision of the whole department, and to the placing of some naval officer of known ability at the head of it.

I have the honor to be, very truly, yours,

JOHN MAGINN,
President N. Y. Pilot Association.

Lieut. T. A. JENKINS, U. S. N.,
Secretary to Light-house Board.

NEW YORK, August 4, 1851.

Dear Sir: At the request of Walter R. Jones, Esq., president of the board of underwriters of New York, I hereby give you my views relative to lights, buoys, and beacons, for the south coast of Florida and the harbor of New York. I have had experience as a shipmaster, twenty years, and the past seven years I have been employed as underwriters' agent. I have given much attention to this subject. I was pleased to learn that Government had resolved to protect the interests of commerce, by selecting competent and scientific gentlemen to look after this important work.

As regards lights, &c., you ask, is it necessary to build a light-house on Flynn's knoll? I answer distinctly, no. A light-ship or a large buoy of a tripod form, would mark the danger, and my reason for not building a light-house is, the danger of affecting the channel. This shoal may increase, and it may decrease; and it will strike the mind of a careful observer, that it is dangerous to alter the natural current. The depth of water is now about sufficient for our ships-of-war and merchant ships—twenty-three feet at low water is the most that can be found on the bar. As regards the buoys of this harbor, some of them are small, and more attention ought to be paid to them, especially in the winter time, when the floating ice often removes them. Our merchant and steamships are increasing in size and numbers, and the importance of this harbor is felt by every State in the Union.

You ask, is the light now moored off Sandy Hook useful to commerce? I answer yes, and ought not to be removed. I have, in my own experience, known the advantage of this light-ship in foggy weather; also, in the winter time, when snow storms occur. It is a good departure for the bar. The light-ship bears nearly E. SE. six miles from the bar buoy, and about E. by S. eight miles from Sandy Hook light-house. A large bell on board, to ring in thick weather, and a signal gun, would be very beneficial to navigators. I believe this light-ship has been the protection of life, and much property has been saved since she was stationed there. I have resided the past six years at Key West, Florida, and have given particular attention to the subject in view of that coast. The light-house on Garden Key, Tortugas, is now a very good light, and is kept in perfect order; in clear weather it can be seen eighteen miles from aloft. A beacon should be placed on Sand Key shoal, near Loggerhead Key, one of the most western keys.
This bad shoal, on which many vessels have been lost, lies about W. SW. five miles from the light-house. A beacon on Bird Key shoal, about S SW. three miles from the light-house, would be of service. A beacon on a shoal about NE. by N, six miles from the light-house, should be erected; also, a beacon on Rebecca shoal, about twelve miles to the eastward of Garden Key light-house. The light-house now in progress on Sand Key, to replace the one destroyed by the hurricane of October 12, 1846, will be of great importance; eight vessels, and the value, $425,000, have been ashore near this spot the past sixteen months. The light on Key West is a very good light, and kept in perfect order; but when Fort Taylor is finished it would best serve the interests of commerce to have it removed to the fort. The light-ship in the north-west passage is well kept, but the light is not brilliant. As the coasting trade is soon to be done by steamships, this passage will be very important. A few beacons could be easily erected near the bar, as I learn from Captain John Rogers, that he has found more water through this passage than the pilots know of. This gentleman has also found more water in over the reef than has been known before, and I refer you to him to give the location for buoys and beacons required to enter the harbor of Key West from the Gulf. A beacon on the eastern Sambos, and on the American shoal, (all in sight of Key West,) and on the edge of deep water, is much required. A beacon to replace the one destroyed in 1846, on Looe Key, is very much wanted. One on Alligator shoal, and Sombrero, with one on the Fowey rock, near Cape Florida light-house.

The light-ship on Carysfort reef has been lately put in fine order, and the light very much improved. The light-house now building on Carysfort reef is a magnificent work, and this light can be seen when lighted 25 miles, and by day it will be a good mark for a departure. I trust it has strength to resist the violence of hurricanes, (as all light-houses should be built with this in view.) The light at Cape Florida is very good, and well kept. The beacons on the several shoals, that I have alluded to, should be made of iron screw piles; it is true, salt water in time will destroy them, but the cost is trifling, and the beacons could all be erected in a short time, and pay the expense by the use the coast survey will make of them.

The expenses of coast survey come from the national treasury, and the benefit arising from these beacons will lessen their expenses, and give great facility to this important work of giving to navigators a correct chart of the most dangerous parts of our coast.

The known ability of the gentlemen composing your board is a sufficient guarantee to all persons interested, that Government will act promptly in such improvements as you may recommend.

Very respectfully, your obedient servant,

JNO. C. HOYT.

T. A. JENKINS, Esq.,
Secretary Light-house Board, Washington City.
TREASURY DEPARTMENT, November 10, 1851.

SIR: I transmit, herewith, a letter from the Chamber of Commerce at New York, with its enclosure, which is in reply to a communication from the Light-house Board.

Very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Com. W. B. SHUBRICK,
President Light-house Board, Washington.

The committee appointed by the Chamber of Commerce to report upon a communication made by the Light-house Board to the Chamber, relative to improvement in lights, &c., to the navigation of New York bay, do report:

That they do not think it advisable to go far into the question of the quality of our lights on the sea-coast as all the testimony is in favor of the general superiority of French and English lights, over those of our country; although we have recently much improved the efficiency of ours, still much remains to be done. The committee will therefore confine themselves to such additions and alterations as are in their judgment necessary to make this harbor accessible as it should be by night or day, which is not the case at present.

The additions necessary to the safe navigation of this port are—

The speedy completion of the beacon on the southeast point of Romer, and the lights on the west end of Long Island near Fort Hamilton, intended as a mark for the main-ship channel at night; both the above are already appropriated for by Congress. A light-house is necessary on Flymu’s knoll, that steamers and vessels of heavy draught of water may come in at night, which now is a matter of great danger on account of the narrowness of the channel; and they are obliged to either anchor or lie-to outside. For this thirty thousand dollars has been appropriated, and this committee are informed that persons are ready to construct one for the above sum, and it is to be hoped that no more delay will take place in its construction.

A beacon of a small size is also wanted on the shoal ground off the west bank.

The light-house at Fire island should have more illuminating power, and a light of moderate brilliancy of a distinct character from that of Fire island or Montauk point should be placed midway between them, as a sea-mark, the south side of Long Island being difficult to recognize between those two points, a distance of sixty-seven miles.

The buoys of our harbors are, as far as we can hear, in good order, and now well attended to. The former practice of taking the can buoys up too early and putting them down too late, having been on representation of its impropriety abandoned.

The lights on the Highlands of Navesink (Fresnel’s) are equal to any
lights of the same class elsewhere, and of their general management, we hear no complaint; the same may be said of our harbor lights generally.

CHAS. H. MARSHALL.
GEO. W. BLUNT.
STEPHEN JOHNSON.

NEW YORK, November 1, 1851.

Extract from the report of Captains Brewster and Dutton, and Major Smith, United States engineers, for revising the plan for a light-house on Flynn's knoll, near Sandy Hook, New York harbor.

The attention of the undersigned was first called to the position the light-house was to occupy on the shoal. The Department, in its instructions, says: "It is believed that the position of the light-house has been well determined by a board of naval officers, and no deviations at all material from this position can be allowed." The board of naval officers referred to in a communication addressed to the commissioners of the Navy, under date of the 26th May, 1837, describes Flynn's knoll as one of the several shoal spots, composed of fine dark sand, extending along the water-edge of a bank which forms the northern boundary of the ship-channel into Raritan bay, at the eastern end of this knoll, and eight hundred feet from the channel. We have placed a buoy to mark the most eligible position for the location of the light-house. The buoy is in twelve feet at low water, and bears from Sandy Hook light-house, according to Geilney's chart, N. 13° W. The breadth of the channel directly between the Knoll and the Hook, embracing a depth of not less than twenty-seven feet, is shown by the same authority to be 2,560 feet by this passage. All vessels are obliged to enter and depart, whose draught will not permit them to pass through the swash channel.

The board of naval officers further states: "The object of a light-house on Flynn's knoll would be to mark distinctly the boundary of the main channel to the north; and in conjunction with the principal light-house on Sandy Hook, it would be of great service to vessels crossing the bar, either by day or night, and an unerring landmark for strangers desirous of seeking safe anchorages in the bay. It would answer also as an additional guide for entering the swash channel.

It is also said: "Since the erection of the light-house on Sandy Hook, which was first lighted, according to the best information we have been able to collect, about eighty years ago, the point has encroached very considerably upon the sea, and particularly in a northerly direction, from which the light-house is now distant from low-water mark on the north point 4,550 feet, and is consequently of less advantage to vessels running into the bay at night; because in thick or hazy weather they cannot correctly calculate the distance from the light to the fairway, and in apprehension of running upon the Hook, a disaster by no means unfrequent, they sometimes keep too far to the north, and fall on Flynn's knoll. To obviate the difficulty arising from the remoteness
of the light-house from the channel, beacons which are lighted at night have been placed at the north and at the northwest points of the Hook; but so rapidly has the beach made out to the north, that it was found expedient to advance the eastern beacon, about six years since, several hundred feet, and again it has become necessary to move it forward at least six or seven hundred feet further.

The foregoing facts in relation to the constant extension of Sandy Hook in a northerly direction are important as regards the stability of Flynn's knoll. As the volume of water passing Sandy Hook is about the same in any given period of time, the encroachment of this point on the sea would seem to indicate that the main channel is gradually increasing in depth, or that the southern side of Flynn's knoll, opposite this point, is wearing away. It was this consideration, as well as the very exposed position selected by the board of Navy officers for the site of the light-house, that induced the suggestion to two of the members of the naval board, at an informal meeting held at the city of New York, of the expediency of locating the light-house further to the westward on the knoll, at the position marked B, on the sketch of Gedney's chart herewith. This position, besides placing the house on a broad part of the shoal, would have been protected from heavy southeast gales by the northern extremity of the Hook; at the same time, it would probably have been beyond the influence of any abiding action to which a greater proximity to the northern point of the Hook might be liable.

The position, however, chosen by the board of naval officers involved important considerations in respect to the main and swash channels, which rendered any material change in the site of the light-house inadmissible. It was at the same time stated that two buoys had been placed on the knoll, about —— yards apart, designating the extreme east and west limits between which sites might be selected for the house. This choice of position was therefore confined to very narrow limits, it being necessary, on the one hand, to avoid that occupied by the preparatory works of Major Smith, marked S, on the sketch, which had been selected near the western buoys; and on the other hand, it seemed desirable to leave as much space between the eastern extremity of the knoll and the light-house as possible. The position chosen is marked E, on the sketch, and is further indicated by a circle drawn to the same scale with the chart, the circumference of which circle is the exterior boundary of the permanent breakwater surrounding the house when completed.

It will be perceived, by inspection of the chart, that this is the broadest part of the east extremity of the shoal; the surface for a considerable space being nearly level, and at a depth of fourteen feet below the plane of low water. The bearing of the centre of this position from the lighthouse on Sandy Hook is N. 17° 30' W., distant 8,823 feet; from the northern point of the Hook the distance is 4,918 feet; from the eastern extremity of the knoll 1,262 feet; from the northern edge of the knoll, opposite the point, 398 feet; from the southern edge of the knoll, opposite the point, 60 feet; from the centre of the position selected by Major Smith, 365 feet; and from the buoy (marked N on the sketch) placed by the board of naval officers as mentioned in their communic-
tion to the Commissioners of the Navy, 717 feet. With regard to the altitude of the light, the board of naval officers, in the same communication referred to, suggest that it be of the same height from high-water mark as that on Sandy Hook. Captain Kearney, one of the members of this board, in a subsequent communication to the Secretary of the Navy, in answer to certain interrogations propounded by the Secretary of War relative to the light-house proposed for Flynn’s knoll, says “that it should not be less than eighty feet from the level of the sea to the lantern of Flynn’s Knoll light; and for reasons more at large, I beg to refer you to a report I made, in connection with Captains Sloat and Perry, to the board of Navy commissioners. This officer further states: “Inasmuch as the light at Flynn’s knoll is the most important, other lights in its vicinity should be accordingly, not only differing distinctly in color, but also in their height. The Flynn’s Knoll being the highest and most conspicuous, would guard against any mistake that otherwise might occur, especially in fogs, when only at certain times the top of the light-house can be discerned. This error of mistaking Sandy Hook light for Flynn’s Knoll light-house in a foggy day, and steering accordingly, might prove fatal. It is not an improbable thing that such would be the case, was there not a greater distinction in the height of these lights; therefore, to produce the greatest difference possible, I would recommend the following alterations to be made: Premising the light on Flynn’s knoll to be eighty feet high, I would reduce the present light-house on the Hook, so that including the elevation of the land or sand hill on which it stands, it should be no more than fifty feet above the level of the sea. This would give it still a considerable elevation over the beacons, and preserve its usefulness as a leading mark for pilots, for which it is only serviceable now after they get into port and bound up the bay.”

Captain Sloat, another member of the board of Navy officers, in a letter to the Secretary of War under date of December 18, 1838, in answer to the question, “What is the least height for the light on the knoll, that will answer the purpose of navigation?” says “in my opinion, not less than sixty feet above high-water mark to the base of the lantern.” I did not preserve a copy of the report made to the Commissioners of the Navy on the subject, but I believe that the height fixed upon by the board, after well considering the subject, was eighty feet. The light on Sandy Hook is about one hundred. It was thought advisable that it should be nearly the same, to enable the navigator to judge more correctly his distance from each. The point opposite the knoll is very dangerous, and the water is very deep to the beach, so that the lead cannot be trusted.

In accordance with the general views of the board of Navy officers, the exterior edge of the balcony of the lantern has been fixed at eighty feet above the level of high water, making the altitude of the centre of the light, above the same plane, about ninety feet.

"The examination of the bottom at Flynn's knoll, which was completed on the 18th ultimo, showed that the sand was coarser, more compact, and less intermixed with mud at the surface and near it than it was lower down. The examination was carried to the depth of 27 feet below the surface of the sand, with the aid of an air-pipe of eight inches interior diameter, which gradually settled as the sand was excavated from within, by means of a cylindrical bucket with a valve at the bottom. Every bucketful raised, except the first, which contained the surface crust, indicated the dissemination of mud through the sand, though not to such a degree as to authorize the impression that a stratum exclusively of mud had in any instance been passed through. Nor was the appearance different from what is usual in the formation of shoals of sand in positions contiguous to a mud bottom, such as that in the vicinity of Flynn's knoll is represented to be."

Port Warden's Office,
New York, June 17, 1851.

Sir: In compliance with the directions of the Light-house Board, asking for any information which may be at my command in relation to improvements in lights and other aids to navigation in the vicinity of New York and the approaches to it, I herewith send you my answers to the following questions, viz:

Is there any necessity for a light-house on Flynn's knoll? In reply, I would say no.

Would a system of ranges on the Jersey and Staten Island shores obviate the necessity for placing a light on Flynn's knoll? A system of ranges on the Jersey and Staten Island shores would be far more beneficial to the navigation than a light on Flynn's knoll.

Have vessels—and how many—been wrecked and suffered for want of a light on Flynn's knoll, within a specific number of years? I have only known some two or three vessels to have been wrecked on this shoal since 1818.

Have vessels been prevented from running in for want of a light on Flynn's knoll? I should say not, so far as relates to vessels having pilots on board.

What particular advantage is to be gained by placing a light on Flynn's knoll? A light on Flynn's knoll would designate, of a clear night, the starboard or north side of the channel, to vessels bound in; but in hazy weather it would be liable to be confounded with the Hook lights.

What is the condition of the buoys and dumb beacons? The buoys, generally, are in pretty good floating condition, and the dumb beacon, Romer shoal, is a solid and substantial structure.

Are the buoys of proper dimensions, shape, and color? A cone placed on the head of the present can buoys would make them much more con-
spicious; for, in rolling, they would be more likely to attract the eye. The color of the buoys has too much sameness to be depended upon in rough weather by vessels passing quickly through the water— particularly in hazy weather.

Is there a sufficient number of buoys and dumb beacons at present? There is a sufficient complement of buoys when the usual number is laid down. I would not hesitate to say, that, if a dumb-beacon were placed on Romer shoal—on the southeast part—and also one on Flynn's knoll, near the edge of their respective channels, they would be important as guides in coming in or going to sea.

Is the light-vessel near Sandy Hook properly placed; and if not, what position is proposed? In my judgment, I say that the light-vessel is properly placed for large-class ships and steamers.

What reasons for wishing the position of the boat retained or changed? My reasons for the ship retaining her present position are, that she has proved to be an important guide, in taking a departure from her to run for the bar. She is also useful to the largest-class ships—to lay by her during the night, while waiting for an opportunity to run in. She is particularly serviceable to pilots in aiding them as a mark to steer from, to run in for the bar. The only good reasons that I can give for a change would be, in exchanging the vessel itself for a new one, as she is getting old. A new light-ship of greater length, and with all the modern improvements in model, light-ship, &c., would add much to the safety of commerce, to and from this port. And, in conclusion, I would strongly urge the present light-ship station to be retained.

I am, with great respect, your obedient servant,

ROBERT T. NORRIS.

THORNTON A. JENKINS,

Lieutenant U. S. Navy, Secretary to Light-house Board.

---

TREASURY DEPARTMENT, August 15, 1851.

SIR: I forward, herewith, a proposition from Isaac Smith, Esq., to erect a light-house on Horseshoe reef, near Buffalo, New York, for the consideration of the Light-house Board, and should be pleased to have as early a report on the subject as practicable with their views; for if the plan is to be adopted, it will be desirable to have it under way with as little delay as possible.

Very respectfully, your obedient servant,

WM. L. HODGE,

Acting Secretary of the Treasury.

COM. WM. BRANFORD SHUBRICK,

President Light-house Board.
Office Light-house Board, August 21, 1851.

Sir: I enclose, herewith, the report of the committee of this board, to which was referred the project of Mr. Isaac Smith, for a light-house on Horseshoe reef, in the Niagara river, which report has been adopted by this board.

Very respectfully, your obedient servant,

WM. BRANFORD SHUBRICK,
President Light-house Board.

Hon. Wm. L. Hodge,
Acting Secretary of the Treasury.


The committee to whom was referred Mr. Isaac Smith’s plan, report as follows:

The ideas and propositions contained in Mr. Isaac Smith’s communication, referred to the Light-house Board by the Treasury Department, on the 15th instant, have been maturely considered.

There is much in this project that is novel, as the board believes, and much that seems to be ingenious. The board must, of course, judge of it as presented them, they having no right to interpolate changes or modifications; and although the letter and the sketch presented by Mr. Smith, and explanations given personally by him, exhibit, in general terms, his intention plainly, they do not meet, much less remove, doubts which the board cannot, after much reflection, but entertain as to practical difficulties and cost of execution. The project is vague or not full, or, at any rate not satisfactory to the board, as to the means of overcoming important practical difficulties; it relies for essential matters on untried, if not doubtful expedients: it does not contain estimates, calculated in detail, of the cost of executing the several parts, especially those deemed to be most difficult.

The committee must add that, with their understanding of exposure of the site for which Mr. Smith’s light-house was intended, they are very doubtful whether it will of itself be sufficient to resist the force of the ice that, under certain circumstances might press against it; and if an ice-breaker be indispensable to its security, their doubts are the greater as to its title to preference over projects founded on well-known principles and processes. Accordingly, the committee does not feel warranted in advising its adoption by the Government, either as a general project or for any particular site.

JOS. G. TOTTEN,
Brevet Brig. Gen’l and Col. of Engineers.
JAMES KEARNEY,
Lieut. Colonel, Topographical Engineers.

Adopted.

51 L H P

Belmont, Queenstown, Cork, July 31, 1851.

Dear Sir: We are in receipt of your favor of 26th May, with the interesting documents enclosed in it, and have much pleasure in replying to your inquiries respecting the screw pile, being satisfied that the more extensively it is known the more extended will be its application. All the engineers of any standing in these countries have expressed themselves strongly in its favor; of these we may mention Messrs. Walker, and Burgess, Rendal, Brunel, Cubett, &c., all of whom have adopted it in foundations where the ground was penetrable or covered by the water, and in every case it has proved eminently successful.

The screw-pile light-houses inspected by you and Lieut. Bache, when in this country, are all standing as you left them, in perfect order, no repairs having been necessary, with the exception of paint; since then, some others have been erected by us. In the year 1849, we placed a screw-pile light-house in Dundalk bay for the commissioners of Irish lights; in 1850 we laid the foundation of a screw-pile light-house on the Chapman sand, off Sheerness, for the corporation of the Trinity house, London, and we are at present constructing a screw-pile light-house on a shoal in Cork bay, for the Irish light-house board, all of which we hold to be a sufficient reply to whatever may have been urged against the system.

The Dundalk light-house stands on nine wrought-iron piles placed seventeen feet in the ground; it has been sometime lighted, and is a great boon to that rising town. The Chapman Sand light-house is also on nine wrought-iron piles placed thirty-nine feet in the ground, and the superstructure is now advancing under the management of the engineers of the Trinity House, Messrs. Walker & Burgess.

The construction of the Cork light-house, the foundation of which is now laid, has, with the exception of the lantern, been intrusted to us by the Irish light-house board, of all which works and others of still greater importance you will shortly have ample details, with drawings, from a small volume at present in the press, some copies of which we shall have much pleasure in forwarding to you; but probably the most severe test to which these piles have been subjected may be seen in three beacons placed by us on the Kish, Blackwater, and Arklow banks, dangerous shoals ten or twelve miles off the coast of Wicklow and Wickford.

Each beacon consists of a massive wrought-iron pile of great length, surmounted by a large ball; and, although depending for support on a single screw at their base, they have all withstood the storms of several winters; but these beacons are not of themselves of much importance, having been placed principally for the purpose of pointing out the sites of future light-houses.

As to our screw moorings, we have several persons constantly employed in putting them down, in the various bays and harbors of the United Kingdom; they being now preferred in these countries to all other moorings.
With regard to our light-houses, we have not found it necessary to make any material alteration either in their principle or form, although we have in the materials used, as we now prefer wrought iron and British oak, to the fir timber from the Baltic formerly employed. Wrought-iron piles being in most cases especially necessary by reason of the various descriptions of sea-worm which everywhere infest our coast. Wood, however, is more economical, and may be safely used where the piles are occasionally open to inspection throughout their entire length, as in the case of the Fleetwood and Maplin Sand light-houses.

The slight vibration occasionally observed, so far from detracting from their strength, really renders them more stable, in the same manner and for the same reason that springs have been found useful when applied to heavy wagons; sudden shocks being thus in both cases considerably softened and rendered comparatively harmless; of this the Small's light-house, now standing about sixty years, is a remarkable example, which, together with the objections to cast iron in sea-foundations, and other matters interesting to engineers, you will find alluded to in the pamphlet which accompanies this letter.

Wooden piles when placed in fresh water, being free from the attack of worms, might (should economy be an object) be employed with advantage to support light-houses and beacons on the shoals of lakes and rivers. You say the chief objection urged by those opposed to screw-pile foundations are, too great vibration, excessive torsion, and, in some localities, not sufficient stability to withstand the force of the elements opposed to it. Of vibration we have spoken already, and hold that it is in no way injurious where not so great as to affect the light, and where the structure is placed on a base of sufficient breadth. If by torsion be meant the power employed in screwing in the piles, that can be rendered innocuous by giving to the screws the proper form, and to them and the piles strength sufficient to bear the twist; or, should a rotary vibration of the house be meant, this can be entirely prevented by the application of angle braces between the outer piles, as shown in the Belfast and Fleetwood light-houses.

As to giving to such structures power to resist the elements, that must in every case depend on the judicious application of materials of sufficient strength, of not difficult solution, as shown in the success that has attended all our works. Some attempt has also been made in this country to lessen confidence in the screw pile, by asserting that the Minot's Ledge light-house, destroyed last April, was placed on screw piles; but this we understand to be a mistake, and would gladly have your authority for its contradiction. The accident was possibly owing to screw piles not having been used in the construction, or too insufficient breadth of base.

We shall also, at all times, be most happy to give you any information in our power on the subject of these works with which we may be connected; and should the presence of one of us tend in any degree to the more extensive adoption of the screw pile or mooring in the United States, our junior is quite prepared to pay your country a visit.
It now only remains for us to express our high gratification at your appointment as secretary to this most important commission, and to subscribe ourselves with the highest respect,

Your obedient servants,

A. MITCHELL & SON.

THORNTON A. JENKINS, Esq.

Great George St., Westminster,
August 1, 1850.

My dear sir: I have carefully examined the design for a landing pier at Osborne, in the Isle of Wight, which is, in my judgment, well suited to its purpose, as embracing lightness and elegance of appearance with great strength and firmness of construction, at the same time offering the least possible obstruction to the rise of the tide or stroke of a wave.

These advantages are obtained chiefly by the use of the patent screw piles of wrought iron, which are eminently adapted for the erection of structures of this kind, affording, as they do, a great facility of execution, and in matters of this kind especially, of which I may instance the pier for landing of passengers and goods, driven into the surf or swashing of the sea at Coustoun, in Ireland, in which (as probably it would in this case) the pier formed the staging for its own construction. I am very much in favor of the patent screw, having used it for very large moorings in the river Mersey, and my son, during the last year, built a large railway bridge in the fens of Lincolnshire, founded and supported entirely on screw piles; and I believe they have been extensively used by Mr. Bendel for the construction of piers used in the erection of the great Portland breakwater. Nor can I conceive anything better adapted for a landing pier at Osborne, than a well-framed platform of good timber, supported on piles of wrought iron, screwed firmly into the bottom of the sea to the requisite and proper depth; and were I about to erect a pier, I should certainly adopt the same mode of proceeding.

I am, my dear sir, yours faithfully,

W. CUBETT.

To CHARLES MANDY, Esq.,
Secretary, Institution Civil Engineers, London.

Notes.—During the summer of 1850, Mr. Mitchell laid down a screw-pile foundation for a light-house on the Chapman sands, near the mouth of the Thames. These piles, nine in number, and six inches in diameter, were screwed down forty feet, although the bottom is very hard; but this depth was demanded by the contract. The heads of the piles were framed together, and the superstructure is to be completed by the engineer to the Trinity House, Mr. James Walker. Second, Mr. Mitchell has contracted with the Trinity House to put down a similar foundation for another light-house on the Goodwin sands. Third, the son of Mr. Mitchell was employed last December in erecting
a screw-pile light-house, at the entrance of Cork harbor, for the Irish Ballast Board. Fourth, Mr. Mitchell has been called upon for estimates to erect a screw-pile light-house at Singapore, and also for a viaduct many miles in length, to be constructed over the marshes in the province of Gararat, (India,) terminating in a screw-pile pier for shipping cotton, wool, &c. Fifth, it is proposed to use 2,500 screw piles on the Portland breakwater. These form a viaduct, on which the cars loaded with stone from the quarries, are made to travel by steam power. The stone is dumped off each car into the water, the piles being thus buried up in the operation. The great expedition and facility obtained by the use of this screw-pile viaduct or railway cannot be overestimated, as the train is loaded at the quarries, and then rapidly drawn to the place of deposit, where the trap doors in the bottom of the cars are opened and the whole load discharged in a few minutes. This is one of the greatest works of modern days.

Screw Moorings.—It is highly desirable that these useful moorings should be introduced for securing our buoys—the loss and repairs of which now cost annually $20,000, owing to the insufficient moorings we now use in the shape of iron or stone blocks; a large number of buoys are swept away every year, or else dragged off into deep water, or out of true position. The adoption of this mooring is general in Great Britain and the north of Europe.

Extract from Parliamentary Report of 1845.

Iron Screw-Pile Light-House Towers.

"The attention of your committee has been called to the erection of fixed light-houses, where floating lights are now maintained, and to the substitution of iron for stone and brick houses, and there is reason to believe that a considerable reduction of expense in the light department may be effected by the adoption, in part, of these improvements. Your committee directs particular attention to the evidence of Mr. Alexander Mitchell, civil engineer, whose invention of the screw pile, the efficiency of which has been tested for some time, in one or two places, recommends itself as affording the means of substituting, in some places, fixed for floating lights; whereby the double advantage of increased security and efficiency of light, and a saving of expense, both as regards construction and maintenance, may be obtained.

"For details, your committee refers to the evidence of Mr. Mitchell."

Extracts from British Parliamentary Report of 1845.

23 Great George Street,
September 25, 1848.

Sir: The reference on the important subject of lightning conductors, is to Mr. Faraday and to me. On receiving it, I prepared drawings of
the buildings to which our immediate attention was required, with an explanation of their present conductors.

These were considered at a meeting with Mr. Faraday, when he explained the principles and their application to the several cases deduced from his copious experiments and scientific observations.

I have since received from him the accompanying report for my signature along with his, but the report is altogether Mr. Faraday's, and therefore I prefer adding my approval of all it contains in this separate sheet, and recommend that authority be given me to act upon it.

I am, &c.,

JAMES WALKER.

---


September 25, 1843.

The undersigned have, according to their instructions, met and considered the circumstances under which light-houses are placed as respects lightning, and have arrived at the following conclusions:

That light-houses should be well defended from the top to the bottom.

That as respects the top, the metal of the lantern and upward is sufficient to meet every want, and satisfy every desire and fear.

That for the rest of the courses down the tower, a copper rod three-fourths of an inch in diameter is quite and more than sufficient.

That at the bottom where the rod enters the earth, it is desirable at its termination to connect it metallically with a sheet of copper three or four feet long, by two feet or more wide; the latter to be buried in the earth so as to give extensive contact with it.

That glass repellers are in every case useless.

That glass thimbles are not needed, but do no harm.

If the repeller be removed, and the joint on the vane be terminated as the lightning-rods usually are, and then the metal of the lantern be strongly attached to and cemented with the upper end of the copper rod, and the rod continued down the tower to the earth, and the sheet of copper buried in it, such a system will be an effectual and perfectly safe lightning conductor.

That then there need be no rod end rising by the side of and above the lantern.

The rod may (if required on other accounts) come down on the inside of the building or in a groove in the wall, but should not be unnecessarily removed from observation and inspection.

That all large metallic arrangements in the stone-work in other non-metallic parts of the tower of the light-house, such as tying bars, metal flues, &c., should be well connected by copper with the conductor.

That the vicinity of two metallic masses, without contact or metallic communication, is to be avoided.

That as to the South Foreland high light, the lantern, the central stone, and the copper rod proceeding from it to the earth, connected as they now are, form a perfect lightning conductor, even without the rod that is there erected; but
That it is important, casual arrangements should never be depended upon for lightning conductors, but a copper rod be established for the especial purpose; for if the former be trusted to, the carelessness or ignorance of workmen may, at after periods upon occasions of repair or cleansing, cause the necessary metallic connection to be left imperfect or incomplete, and then the arrangement is not merely useless but dangerous.

That as to the Eddystone, it is desirable to connect the system of wrought-iron ties in it with the lightning conductor, by joining the lower part of that iron rod which is nearest to the conductor with the latter by a copper rod or strap, equivalent to the conductor in sectional area.

That the Dungeness light-house is in a very anomalous condition; to rectify which the two repellers should be removed, and also the representative of the top of a lightning rod attached to the flue; and that then a good copper conductor should be attached to the metal of the lantern, upon the principles already expressed.

JACOB HERBERT, Esq., &c.

M. FARADAY.

TRINITY HOUSE, LONDON,

September 29, 1843.

SIR: The report of Mr. Faraday on the subject of lightning conductors, having been laid before the board, together with the letter from yourself by which it was accompanied, I am directed to transmit the enclosed copy of the said report to you, and to signify the request of the board that you will cause the light-houses of this corporation to be protected by the means recommended by Mr. Faraday, and in which you have expressed your entire concurrence.

I am, &c.,

J. HERBERT.

JAMES WALKER, Esq., &c.

FOG SIGNALS.

Extracts from the evidence of A. Gordon, Esq., civil engineer, &c., London, before the select committee on light-houses, 1845.

Q. Have you any suggestions to offer as to the efficiency of the floating lights?

A. I would suggest that in foggy weather the gong or bell should be superseded by the use of a shrill scream or whistle—such as the railway whistle, giving it sound by a bellows, and having the sound directed round the horizon by reflectors similar to those of Bordier Marcet, for reflecting light. The vibration of air follows very much the same lead as the vibration of light; and if a sound is made in the focus between the two reflectors of Bordier Marcet's apparatus, it would be spread equally
round the horizon. This apparatus consists of two conoids,* with the apex of each cut off; the one erect, the other inverted, and the focal position is in the centre between them. When this apparatus of Bordier Marcet is cut in two, it presents a section of a parabola on one side and a parabola on the other; in other words, a parabola all around. Its form is generated by the revolution of a parabola between the two conoids, when they are so placed. This form has the property of direct- ing all the sounds which impinge upon the parabolic lines of the conoid into a horizontal plane all around; and by this system of reflection, I think sounds from these floating light-vessels could be conveyed a much greater distance than they are at present.

Q. Have you seen experiments made as to the conveyance of sound, in stormy or hazy weather?

A. I have heard the gong in hazy weather, and I am convinced that the locomotive whistle would be heard much further.

DABOLL'S FOG-WHISTLE AT BEAVERTAIL LIGHT-HOUSE. *

Boston, July 3, 1852.

SIR: The Light-house Board, specially instructed by the Department, have visited the Beavertail light-house, and examined the fog-whistle of Mr. Daboll.

The board had a favorable opportunity to witness and judge of the power of the whistle in passing up the sound, on the morning of the 29th ultimo. They left New York on the evening of the 28th, in the steamer Empire City; the early part of the night was clear, but as the steamer approached the east end of Long Island and the passage between Beavertail and Brenton's reef, the fog became so dense that navigation would have been extremely hazardous without some better guide than the compass and lead, and this was found in the whistle, which sent its clear and shrill notes far over the water, indicating the bearing of the point on which it is placed, much more accurately than a bell or a gun would have done, and enabling the steamer to arrive, with little loss of time, at her port.

The board recommend the expenditure of the appropriation made by Congress for the purpose of placing the whistle at the other points contemplated, and are of opinion that the substitution of horse-power for hand-power, is very desirable in all cases which will admit of it. *

Very respectfully, your obedient servant,

W. BRANFORD SHUBRICK,
President Light-house Board.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

* See Plate.
DABOLL'S FOG-WHISTLE.

Treasury Department, June 11, 1851.

Sir: An appropriation of $2,500 in the light-house act of 28th September, 1850, provides for the erection of fog-signals at the light-houses on Execution rocks, Gull island, (Long Island sound,) Beavertail point, (Rhode Island,) and on board the light-boat at Bartlett's reef, (Long Island sound.)

Under the authority of the above act, one of Daboll's fog-whistles has been placed on Bartlett's Reef light-boat, and is now in operation; application for a contract to erect the same signal at the three other points named has been made to the Department, and, before any action is taken on the subject, it is desirable to have the opinion of the Lighthouse Board, based upon an examination of the signal mentioned, as to its relative merits, and the propriety of its adoption at those points.

You are, therefore, respectfully requested to lay the subject before the board, with the wish of the Department to be favored with its report at as early a day as may be convenient.

Very respectfully,

THO. CORWIN,
Secretary of the Treasury.

Com. WM. BRANFORD SHUBRICK,
President Light-house Board.

Washington, June 8, 1851.

Sir: Congress having ordered an appropriation of $2,500, in September last, (light-house bill, under the head of "Oregon," ) for fog-signals, &c., I propose to put up, in as good working order as that now at work at Beavertail, three machines in addition to the one already completed there, viz: one at Execution Rock light, one at Bartlett's Reef light-ship, and one at Gull island—each by hand-power.

These machines (together with that at Beavertail) to be completed and put in good working order for the sum of $2,500, being the amount appropriated for that purpose—that is, $2,500 for the machines at Beavertail, (for which nothing has yet been paid,) and for three machines to be put up at Execution Rock light, Bartlett's reef, and Gull island. As Gull island and Beavertail are very important points to commerce, it is proposed by me to put horse-power machines at these two points, the same as now at work at Beavertail, (instead of hand-power, the additional expense not to exceed $1,000, including the building for their protection,) and for which additional sum of $1,000 I am willing to await the action of Congress.

The horse-power machine now at Beavertail will not cost more to work, per annum, than hand-power, or what is paid for ringing or tending fog-bells, and it has advantages over manual labor, and will at all times insure a greater and more uniform pressure—being heard, as will be proved by vouchers, from two and a half to ten miles.

Respectfully, your obedient servant,

C. L. DABOLL.

Hon. Secretary of the Treasury.
LIGHT-HOUSE PAPERS.

UNITED STATES REVENUE-CUTTER MORRIS,

Harbor of New York, June 3, 1851

SIR: In obedience to your order under date of the 15th ultimo, directing me to repair to the light-house on Beavertail point, at the entrance to the harbor of Newport, and to examine and report to the Department my opinion of the utility of the whistle recently placed there as a fog-signal, I have the honor to inform you that I have attended to that duty: On the 29th ultimo I proceeded in the revenue-cutter Jackson, accompanied by E. D. Lawton, Esq., collector of the port, and the following is the result of my observation:

Near the light-house I found a whistle used as a fog-signal, with a reservoir of two hundred and twenty-five gallons capacity—two large air-pumps working into this by a crank, connected with which is the arrangement of machinery for the horse-power, and by which arrangement forty or fifty pounds pressure is obtained in about four minutes' time. The machinery is exceedingly simple, being destitute of complication; is easily understood, even by the most illiterate.

Besides the whistle, a fog-horn has been attached, which can be used to good advantage as a fog-signal on board of light-ships, the machinery being so arranged that it can be detached from the horse-power if necessary. A substantial building is also provided in which the machinery and horses are kept. Everything seems to have been provided in this building to give certainty and security to this signal. In order to test this signal, we ran several miles outside; the wind at the time was blowing strong from the northeast and across our wake, the sea was rough and the weather windy. We heard the whistle and horn distinctly at a distance of two and a half miles, and I have no doubt but the whistle or horn either could be heard in calm weather from four to five miles outside. I herewith forward you letters from several of the commanders of steamships navigating the Long Island sound, asking to have located at Execution rock, Bartlett's reef, and Gull island, one of Daboll's fog-whistles; but in place of the fog-whistle at Bartlett's reef light-ship and at Execution rock light-house, I would most respectfully recommend Daboll's fog-horn, to be worked by hand. This would give the navigator a better opportunity to determine his position between Gull Island light and the light-ship at Bartlett's reef in thick weather.

I have the honor to be, very respectfully, your obedient servant,

GREEN WALDEN,

Captain United States Revenue Service.

To Hon. Thomas Corwin,

Secretary of the Treasury.

NEW YORK, May 31, 1851.

SIR: In behalf of the steamboat interest, may I ask of you to use your endeavors to have located at Execution Rock light, Bartlett's reef,
and Gull Island light, the fog-whistle contemplated by the act of Congress of last September, making appropriations for fog-signals, and oblige

Yours, very respectfully,

BENJAMIN BRAYTON,
Master Steamer Empire City.

Captain WALDEN,
United States Revenue Service.

The above recommendations and requests meet with my views upon the subject of fog-signals, and I hope the object above mentioned may be speedily effected.

WM. H. FRAZER,
Master Steamer Commodore.

NEW YORK, May 31, 1851.

SIR: I understand that you have been employed by the Government to make certain examinations on this coast relative to fog-signals, and as an appropriation was made by the last Congress for fog-signals at Execution rock, Bartlett’s reef, Gull island, and Beavertail, I would, in behalf of the navigating interest generally, request your co-operation in having immediately placed at each of these stations one of Daboll’s fog-whistles; being fully convinced, from practical experiments which I have witnessed, that the whistle has decided advantages over bells for marine signals.

Very respectfully, yours, &c.,

JEROME WILLIAMS,
Commanding Steamer Connecticut.

Captain G. WALDEN,
U. S. Revenue Service, New York Station.

DAILY NEWS OFFICE,
Newport, June 27, 1851.

SIR: Feeling a deep interest, in common with the whole commercial community, in the success of the new enterprise at Beavertail—the air-whistle for the protection of navigation—I take the liberty to state, for the information of the Department, that during the dense fogs which have prevailed here quite frequently during the last few weeks, I have repeatedly heard Daboll’s air or fog-whistle, at short intervals both during the night and evening, while sitting in my office. The whistle has been most distinctly heard all over town, and even for two or three miles beyond us. Beavertail is six miles distant from here. I learn from persons who are entirely reliable, that they have often heard this whistle at even still greater distances.

I have the honor to be, very respectfully, your obedient servant,

W. H. CRANSTON.

Hon. Secretary of the Treasury,
Washington, D. C.
NEWPORT, RHODE ISLAND, June 27, 1851.

SIR: In behalf of the interest of commerce and navigation, I am induced to state, for your information, certain facts concerning Daboll's air or fog-whistle, at Beavertail, on this coast. I was for a number of years, say fifteen, keeper of that light, (which is a very exposed situation, and almost always visited with a loud roaring surf breaking in from the ocean,) and during this time the Government erected machinery there for ringing a large bell; but this bell could be heard but a very short distance, and very frequently not outside the breakers. During this time, also, the steamer Providence ran ashore on this point, when making her passage from New York during a fog, and endangered the lives of many hundred passengers, though fortunately she was got off without serious damage. Since Daboll's air or fog-whistle has been placed there, I have repeatedly heard it during the foggy weather, both day and night, at a distance of from six to eight miles. I consider it to be the most important invention that has ever been originated for a marine signal, and sincerely hope that our Government will immediately take such steps as will insure its incorporation into the light-house service of the United States.

With much respect, your obedient servant,

SYLVESTER R. HAZARD.

We concur in the above suggestion, and attest also that we have heard the air-whistle, during the recent foggy weather, six miles and upwards.

E. GIFFORD, Captain.

Peleg Hall.  John H. Watson.
Joshua Fayan.  James Harmonson.
Peleg Eldred.  Henry Tisdall.
G. Woolsey.  James N. Stevens.
Hosea Sevies.  W. S. Newton Allan.

Christopher G. C. Hazard.

Hon. Secretary of the Treasury.

WASHINGTON, June 9, 1851.

SIR: I beg leave to append this note to the proposals made by me on the 7th instant, (for placing fog-whistles at several points therein specified,) as explanatory of the appropriation ordered by Congress for said purposes.

During last fall, Congress being then in session, I exhibited at New York, a hand-power machine for blowing my air-whistle and fog-horn; after a thorough examination of the same, the collector, Mr. Maxwell;
the superintendent of lights, Mr. Coggeshall; the president of the board of underwriters, Mr. Jones; many of the first pilots, packet-masters, &c., together with Mr. Geo. W. Blunt, severally addressed letters to the members of the Committee of Commerce, and other gentlemen of the House and Senate then in Washington, recommending its adoption on light-houses, light-ships, &c., where it was necessary to see the station before passing it in safety.

Besides these, several ship-owners and pilots testified to the importance of the whistle over the bell, from having previously heard the same blown in the sound at Bartlett's reef, where I had placed a machine for experimental purposes.

Upon such recommendations the act was passed making appropriations for fog-signals.

Very respectfully, your obedient servant,

C. L. DABOLL.

Hon. Secretary of the Treasury,
Washington.

CUSTOM-HOUSE, NEWPORT, July 7, 1851.

SIR: In conformity with your directions I proceed to give such information in relation to Daboll's air-whistle as I have been able to collect. It may, perhaps, be proper for me to say that in the outset I did not think very highly of Mr. Daboll's invention, but having witnessed its effects in a more practical way, during the dense fogs that have prevailed of late in this vicinity, I have materially changed my opinion in regard to it.

On Sunday morning, June 15, I awoke about half past 3 o'clock, (my house is in the centre of the town;) I heard the whistle and trumpet two or three times alternately, immediately on awaking, and continued to hear the whistle at regular intervals of a few moments, from half to three quarters of an hour, at which time the New York steamer arrived at the wharf—the fog was very thick. Two days afterwards I heard it again under precisely the same circumstances, except that my windows were open; on the first occasion they were shut. I often hear it when about the streets, even if there is considerable noise of carriages, &c. A great many of our citizens, well-known to me, have testified that they often hear it at times when their attention is otherwise attracted. A Mr. Van Zandt, who lives in Middletown, one mile and a quarter NE. from Newport, hears it very frequently. On the fourth of this month I fell in company with a Mr. Swan, a fisherman of more than ordinary intelligence and respectability; he has for several years been employed by the steamboat companies to blow a horn at dangerous points during foggy weather; he speaks in earnest and decided terms of the utility of the whistle, and says that when he is about his fishing excursions, that being habituated by his employment aforesaid, to listen constantly, he hears the whistle under various circumstances, from five to ten miles distant. Beavertail is six miles from Newport. I might adduce much
more testimony of the same character, but probably you will consider this sufficient; if not, be pleased to forward your further instructions.

Most respectfully, your obedient servant,

EDWD. W. LAWTON,
Collector.

To THORNTON A. JENKINS, U. S. N.,
Secretary to the Board of Light-house Commissioners.

---

FORT ADAMS, RHODE ISLAND, June 14, 1851.

DEAR SIR: I take pleasure in stating for the information of any one not acquainted with the air or fog-whistle, that in your recent trials with it at Beavertail light, it was distinctly heard here, and seemed to be quite shrill or loud. We at first thought it the mail steamer's whistle as she was passing the fort.

I have no hesitation in saying that I believe it a most valuable discovery to mariners, as I cannot doubt it will be eventually used as a part of the light system of most, if not every maritime country.

I am, very respectfully, your obedient servant,

S. L. FREMONT,
Captain U. S. A.

C. L. DABOLL, Esq.

---

BEAVERTAIL LIGHT,
Canonicut Island, October 8, 1851.

To all whom it may concern: This may certify that, having kept the light here for nearly four years in my own name, I have never heard the bells when they have been rung at Newport, either on Sundays or other days, while at this point.

MRS. DERMARIS H. WEEDEEN.
(Per her order,) GEO. H. WEEDEEN.

---

JAMESTOWN, June 11, 1851.

To all whom it may concern: I have been requested to state the distance and under what circumstances I have heard the air-whistle at Beavertail.

I have heard it several times at my residence at the ferry, at James-town, which is some five miles distant in a direct line, when the weather was foggy and the wind was blowing across the sound at the time.

JOSEPH W. DOCKRAY,
Formerly second mate of the steamer Connecticut.
DISTRICT AND PORT OF NEWPORT,
Collector's Office, July 7, 1851.

SIR: So much new testimony has been collected within a few weeks in relation to Daboll's air-whistle, and as quite a difficulty exists in finding such persons to examine the subject as alluded to in your letter of the 6th May, I have deemed it proper to write you the results of my own observations and those of our community, in preference to incurring expense that would probably add little to what you already know. Perhaps you may have observed that my report in regard to this subject has not been of a very sanguine character; in fact, I did not think very favorably of the invention, although I considered it worth something; but having witnessed its effects in a more practical way during the dense fogs that have lately prevailed, I have changed my opinion materially. On Sunday morning, June 15th, I awoke about half-past 3 o'clock; my house is in the centre of the town. I heard the whistle and trumpet two or three times alternately, immediately on awaking, and continued to hear the whistle distinctly and clearly, at regular intervals of a few moments, from a half to three quarters of an hour, when the morning steamer arrived from New York; the wind was easterly, but light, of course, blowing from the town towards the whistle, and my windows were shut. Two mornings afterward, I heard it again under similar circumstances, (except that the windows were open,) with still greater clearness; I often hear it in foggy weather in different parts of the town, where there is noise of drays and carriages. Captain Thomas Riddell, a very respectable citizen, formerly a shipmaster and merchant, living about half a mile east from me, states that he often hears the whistle at his house distinctly. Captain Joseph Paddock, the surveyor of this port, and all the inspectors testify the same. Mr. Van Zandt, who lives in Middletown, about 1 1/4 mile further from Beavertail light than I do, reiterates the statement. This morning I fell in with a Mr. John Swan, a fisherman, the most respectable of his class, and of good judgment; he has been employed several years by the steamboat companies to blow a horn at dangerous points in foggy weather: he speaks in earnest and decided terms of the utility of the whistle. He says that when he is about his fishing excursions, being habituated by his employment to listen constantly, he hears it at different times from five to ten miles distance, under various circumstances. Beavertail light is six miles from Newport. I have selected these testimonials from hundreds of such as might be obtained of equal authenticity. Mr. David G. Cooke, who went with me in the cutter, will make a written report if desired, but thinks the recent testimonials far more conclusive than those he might give, and you already have the report of Captain Green Walden, who was present on that occasion.

I am, sir, most respectfully, your obedient servant,

EDWARD W. LAWTON,
Collector and Superintendent of Lights.

To S. Pleasonton, Esq.,
Fifth Auditor of the Treasury.
United States Revenue-Cutter Morris,
Harbor of New York, June 3, 1851.

Sir: In obedience to instructions from the Hon. W. L. Hodge, the Acting Secretary of the Treasury, in a communication addressed to me on the 3d ultimo, directing me to proceed to Boston and report to the collector, for the purpose of making an examination of the fog-bell lately erected at the outer light in that harbor, on my arrival in the city, on the 12th, and in the absence of Mr. Greeley, I reported myself to Mr. Wellman, the deputy collector of the port. Finding that the United States revenue-cutter Hamilton had been hauled up for repairs, I hired a small steamer, and, in company with Mr. Wellman, proceeded to the light-house to perform the duty assigned me. In order to test the utility of the bell, and the distance at which it could be heard at sea, we went several miles outside of the light-house while the bell was being rung, with a south wind blowing across our wake and ahead, and while the steamer was under full headway, with the noise of her engine and machinery and the water made by her wheels, and at the bow we heard the bell distinctly at a distance of five miles.

The weight of the bell is 1,375 pounds, and was cast by Messrs. H. N. Hooper & Co., of Boston; it is rung by machinery which runs six hours, striking every forty-seven seconds, with once winding up, which is readily done by one person. The machinery was manufactured at the Lowell machine shop, at Lowell, Massachusetts, and is made in a handsome and workmanlike manner, and does not appear to be liable to get out of order. The structure in which the bell and machinery are enclosed is built of good timber and painted and secured by guys, and I conclude the whole work has been done in a workmanlike manner, very creditable to the contractor. The plan of this bell is much better adapted for a fog-signal than any which I have examined.

I forward herewith, an account in duplicate of my travelling and other expenses.

With high respect, I have the honor to be, sir, your obedient servant,

GREEN WALDEN, Captain,
United States Revenue Service.

Hon. Thomas Corwin,
Secretary of the Treasury.

FRANCE.

Extract from Parliamentary Report, 1834—Light-house service of France.

The light-houses, for the most part, existing on the coast of France before the revolution, had been built and were managed by commercial bodies.

A law of the National Assembly, dated the 15th September, 1792, centralized the light-house, beacon, buoy, and sea-mark service, by placing it under the superintendence of the Minister of Marine, and by charging the Minister of the Interior with the execution of the works agreed upon for this service by the two departments.
A consular order, dated the 11th June, 1802, confirmed the law of 15th September, 1792, concerning light-houses.

An imperial decree of the 7th March, 1805, caused the light-house, buoy, sea-mark, and beacon service to be attached to the official duties of the Minister of the Interior, and from that time they were placed under the immediate direction of the commissioners of roads and bridges. This decree, nevertheless, requires the Ministers of the Interior and of Marine to advise with each other in reference to the establishment of any new light-houses or sea-marks; and this arrangement gave rise to the light-house commission, which was established in 1811.

In 1825, at which period the system of lenticular lights was definitely adopted for lighting the coast of France, this commission is found to have been composed as follows:

M. Becquey, councillor of State, director general of roads and bridges, president of the commission.
M. de Prony, inspector general of roads and bridges, member of the institute.
M. Tarbé de Vaux Clairs, inspector general of roads and bridges, councillor of State.
M. Sparkin, inspector general of hydraulic works at the seaports.
M. Rolland, inspector general of naval architecture.
M. Hailgar, rear-admiral and councillor of State.
M. de Rossel, rear-admiral, director of the repository of charts and plans of the royal navy, member of the institute.
M. Beaufremps Beaupré, hydrographer-in-chief of the royal navy, member of the institute.
M. Arago, astronomer, member of the institute.
M. Mathieu, astronomer, member of the institute.
M. Fresnel, (late Augustin,) principal engineer of roads and bridges, member of the institute, secretary of the light-house commission.

It was by this commission that all the projects and measures adopted since its institution for the improvement of the light-house and sea-mark service were examined and discussed, and one of its most important labors was the study and examination of the general system adopted in 1825, upon the report of Rear Admiral de Rossel, for lighting the coasts of France.

Present organization of the light-house service.

The organization of the light-house service of France, now in force, is briefly as follows:

This service is attached to the official duties of the minister secretary of state for the department of the interior, and is altogether under the direction of the councillor of state, charged with the general administration of the roads and bridges.

In each naval district, the prefect, principal engineer, assistant engineers, and the superintendents of ponts et chaussées, direct or supervise, in the sphere of their respective offices, all that relates to the management of light-houses, sea-marks, and beacons in the neighborhood.
The light-house service, considered collectively, embraces lighting, reparatory works, and the formation of new establishments.

Reparatory works.—The repair or restoration of light-houses, after being authorized by the director general, is, with the roads and bridges works, executed under the superintendence of the district administration.

New establishments.—In the formation of new establishments, the following routine is observed:

The engineers of the district where the new edifice is about to be erected, make a draft of the plan, in conformity with the basis previously determined on by the light-house commission.

This plan is forthwith submitted to the commission, which confines itself to the inquiry as to whether the wants of the service, nautically or otherwise reported on, and constituting the main objects, have been complied with.

It is then presented to the council of roads and bridges, to receive their estimate, founded on the reports made of the architectural arrangements of the system of building, and of the calculated expense. After receiving the approbation of the director general of roads and bridges, and of the minister of the interior, the plan is sent to the prefect of the district, who proceeds to the public adjudication (contract) of the works, and intrusts the engineers with the execution of them.

The lamps and light apparatus are made at Paris, under the care of the engineer-in-chief, secretary to the light-house commission.

The establishment of new light-houses is announced to the public two or three months beforehand, by means of bills and advertisements inserted in the maritime newspapers.

The administration, moreover, publishes annually a summary description of the light-houses and lights on our coasts, and causes five or six thousand copies to be distributed among French and foreign navigators.

The whole of the expenses (with the exception of the cost of lighting a very small number of lights of purely local interest) connected with the light-house service, are supplied from the public treasury. The administration of the customs of France does not levy any special light-house duty upon maritime commerce. This duty, which was abolished by the law of the 18th October, 1793, is at the present time compounded with the tonnage duty, which all vessels pay upon their arrival in port.

LOR. FRESNEL,

Secretary of the Light-house Commission.

Paris, April 30, 1834.

List of the French Light-house Commission in 1851, instituted April, 1811.

The minister of public works, or in his absence the under secretary of state, presides during the sittings of the commission.

M. Arago, commander in the legion of honor, representative of the people, member of the institute and of the bureau of longitudes

M. Mathieu, knight in the legion of honor, member of the institute and of the bureau of longitudes.
M. Mathieu, commander in the legion of honor, rear-admiral.
M. De Hell, high officer in the legion of honor, rear-admiral en retraite.
M. Leroux, commander in the legion of honor, general inspector of maritime engineering.
M. Tretté de Laroche, officer in the legion of honor, divisionary inspector of bridges and roads, charged with the general inspection of maritime works.
M. Fresnel, officer in the legion of honor, divisionary inspector of bridges and roads, en retraite.
M. Reynaud, knight in the legion of honor, chief engineer of bridges and roads, secretary.

List of the Trinity-house Board, London.—Elder Brethren in 1851.

Duke of Wellington, K. G., master.
Captain Sir J. H. Pelly, deputy master.
Captain Aaron Chapman.
Right Hon. Lord Viscount Melville, K. T.
Captain Robert Welbank.
Captain John Hayman.
Captain Henry Nelson.
Admiral Sir T. Byam Martin, G. C. B.
Captain Charles Weller.
Right Honorable Sir J. R. G. Graham, Bart.
Right Honorable Earl of Minto, G. C. B.
Captain Frederick Maden.
Admiral Sir Charles Adam, K. C. B.
Captain Stephenson Ellerby.
H R. H. Prince Albert, K. G.
Captain George Probyn.
Captain William Pixley.
Captain Charles Farquharson.
Captain Robert Gordon, R. N.
Captain William E. Farrer.
Captain Henry Bonham Box.
Right Honorable Earl of Haddington.
Most Honorable Marquis Dalhousie.
Captain John Shepherd.
Captain Edward Foord.
Captain Gabriel J. Redman.
Right Honorable Lord J. Russell, M. P.
Captain John Fulford Owen.
Captain David James Ward.
Right Honorable H. Labouchere, M. P.
Captain Wm. Pigott.
Jacob Herbert, Esq., secretary.
REPORT ON LIGHTS FOR LIGHT-HOUSES.

From the Journal of the Franklin Institute.

HALL OF THE FRANKLIN INSTITUTE,


The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, in compliance with the following resolution, passed by the Franklin Institute at their meeting held April 19, 1849, viz: "Resolved, That the Committee on Science and the Arts be requested to examine and report to the next meeting of the Institute, their opinion of the relative value of the present catoptric system adopted in the United States, compared with the Fresnel dioptric and catadioptric system established in the light-houses in Europe and elsewhere, so far as the same can be obtained from documents in the possession of the Institute," report:

That they have examined the subject intrusted to them with the care and attention which its great importance demands. The immense amount of property, and the many valuable lives dependent on the proper illumination of coasts, and harbors, have attracted the attention of men of science, and nearly all civilized governments. The results have been witnessed in the very great improvements in the structure of light-houses, and in their reflecting and refracting apparatus, especially of the latter.

The committee have studied the voluminous documents containing not merely the opinions of a number of the most scientific men in Europe and America, but the actual practical results described in official statements of light-house boards, in every country where lights of high character have been established. They have examined much voluminous correspondence and have endeavored to avail themselves of every attainable source of information relating to the subject. They have also examined the dioptric and catadioptric apparatus of Fresnel, as displayed in the four orders exhibited before the Franklin Institute.

The catoptric system adopted in the United States is a very imperfect imitation of the European method, which was in use long before its alleged invention in this Union. Paraboloidal reflectors, with lamps placed in their foci, were in use nearly seventy years since in France and Great Britain. The addition of a convex lens in front of the lamp, placed in the focal point of such a reflector, could only have been suggested by a person entirely ignorant of the elementary principle of optics.*

We need not, however, at present enter into the history of the light-house system of the United States. We are gratified to learn that a few improvements have been made by the introduction of better forms of reflectors, and in their adjuncts, as well as in their size, finish, and mountings, but these few cases are merely exceptions to the general rule; and it must be acknowledged that the catoptric system of this

* The small spherical reflectors are also defective in principle, but it is not necessary to discuss the defects of this antique apparatus.
country is, in actual practice, far inferior to the catoptric system of Europe. We do not deem the former to be of sufficient value to contrast with the dioptric and catadioptric system of Fresnel, which is rapidly superseding even the latter (the reflecting system) in its best condition. We therefore limit our comparison to the reflecting apparatus of Europe and the apparatus of Fresnel.

A paraboloidal reflector of the best description receives but two-thirds of the light emitted from the lamp; half of this only is reflected, equal to one-third of the whole, and of this third a portion is intercepted by the intervention of a part of the lamp, diminishing the available light to less than one-third—perhaps to one-fourth; and of this one-fourth, a considerable portion is, from the divergence of the penumbral cone, too faint to produce much effect at great distances. In affixed lights many such reflectors are arranged in one or more circles or arcs; but even when very numerous, viz.: from twenty to thirty, the light is very unequally distributed, and in some azimuths is invisible; when the reflectors are less numerous, viz.: from ten to twenty, this defect is still more manifest.

With the refracting and catadioptric apparatus of Fresnel for fixed lights, the whole circle is equally illuminated, especially when the latest improvements have been introduced, and nine-tenths nearly of the light emitted from the lamp is rendered available;* glass as a refracting material in this system, possessing the same advantage over reflectors as the refracting telescope possesses over the reflecting species. The consumption of oil to produce an equal light might readily be inferred to be much less, and practice has proved beyond a doubt that such is the fact.

The superiority of the revolving and of the flashing lights of Fresnel over the revolving reflecting lights must also be conceded. The superior brilliancy of these lights, the intense concentration of their rays, consequently their penetrating power, as well as their economy in the consumption of oil, being manifest to the committee, it remains to inquire whether their first cost or the expense of their management be greater.

In Europe, for a light of equal intensity, the first cost is not greater, but as in practice the Fresnel lights are much more intense than the reflecting lights, the first cost of the apparatus is, in a small ratio, greater than that of the latter, when of the best description—of course we do not allude to the imperfect apparatus of this country—but their great economy in oil is more than a compensation for the small additional prime cost. They do not require more persons to attend to them, although, in fact, more are required in Europe, for both reflecting and refracting lights, than in the reflecting lights of the United States, but this increase is entirely owing to the importance there justly attached to the maintenance of a steady constant light, which cannot be insured in either system when one keeper only is employed.

The committee are strongly impressed with the great excellence of the Fresnel system—a system which has already been established in nearly three hundred places (and everywhere with satisfaction) in Europe,

---

* Subject, of course, to a small deduction in the passage through the glass.
where it is gradually superseding the old and imperfect catoptric lights, whilst in no instance has it been abandoned after it has been established.

The opinion of scientific men throughout the world is believed to be decidedly in favor of the Fresnel system of lights, where a large arc of a circle requires illumination. In the United States, this invention has been introduced only at one station. The committee earnestly hope that our whole coast, wherever it may be adapted to them, on both oceans and on the lakes, may speedily be provided with this brilliant, economical, and admirably-devised gift of the science and art of the nineteenth century.

By order of the committee:

WILLIAM HAMILTON, Actuary.

——

Extract from the reply of Captain W. H. Swift, Topographical Engineer, to the interrogatories addressed to him on the 14th April, 1842, by the commissioners appointed to investigate the affairs of the New York custom house; being his answers to the first six questions.

1. I am a captain in the corps of topographical engineers, and my present station is Springfield, Massachusetts.

2. I am somewhat familiar with the appearance of the lights in Long Island sound. I have been in the habit of passing and repassing them several times during the year, for twenty years past. With those on other parts of the coast I am less familiar, but have seen many of them.

3. I have noticed the appearance of a number of the lights on the western coast of England, and the eastern coast of Ireland—for example, the Holyhead, Skerries, Tuskar, Mouth of Wyre, and others in the Irish sea. I have not noticed any of the lights upon the coast of France.

4. I have never seen upon our coast a light which approached, in a remote degree even, the brilliancy exhibited by the English lights, which I have referred to above. It is proper that, at the same time, I should state that I have not yet seen the lights at Navesink, fitted with the lenticular apparatus of Fresnel; nor have I seen the lights at Boston and Stonington, fitted with the English illuminating apparatus. I can perceive no reason why these three lights should not be equal in brilliancy to those of the same class in England and France.

5. The great difference in the appearance between our lights and those of England is ascribable, I conclude, entirely to the superior character of the illuminating apparatus adopted in England. In that country, reflectors of proper form and of great size (from twenty-one to twenty-eight inches in diameter) are in use; while with us, as I perceive by a statement of the Fifth Auditor, of December 1, 1839, the reflectors in our lights vary from nine to sixteen inches diameter, three lights only being furnished with reflectors of eighteen inches. Not only the size but the shape of the reflectors affects materially the quantity of light furnished by a given lamp, as may be readily supposed. I cannot state from personal knowl-
edge whether sufficient attention has been given to the shape and reflecting surface of the reflectors; but, judging from information which I have received, and from the report of the naval officers appointed to examine the light-house in 1838, (document 24, H. R., December 13, 1838,) I should infer that, in this respect, this important matter had not received sufficient attention.

The French apparatus (Fresnel's) is again superior to the English. Both are immeasurably superior to own, as all may perceive who will read the descriptions of the several systems adopted by each country.

6. The reply to question five furnishes an answer to the greater part of No. 6. The principle of the illuminating apparatus is claimed to be similar to that of the English, but the immense superiority of the lights of the latter, in point of brilliancy, would seem to disprove the statement. I repeat, that such of the English lights as I have seen far exceed in brilliancy those of our own coast, with the appearance of which I have stated myself to be familiar.

Letter from the Secretary of the Treasury of the United States, with reports and documents; 25th Congress, 3d session, H. R. Doc. 24.

Report of Mr. Davis; 6th Congress, 1st session, S. Doc. 474.

---

Report of Professors Pierce and Lovering, of Harvard University, on Fresnel's dioptic apparatus for light-houses, February 1846.

To the President of the Boston Marine Society:

The undersigned respectfully submit the following report upon the sea lights exhibited by I. W. P. Lewis, Esq.:

We have carefully examined these lights, and find them to be identical with Fresnel's catadioptric lights, which are well known to European navigators, and which, after repeated and earnest investigations by men of the highest scientific character, and by those practically familiar with the subject of light-houses, have been approved and adopted by the principal maritime powers of Europe, viz: France, Holland, England, Sweden, Denmark, Spain, Sardinia, and Naples.

They have, from the time of their introduction, been gaining the favor of the world, and there are now two hundred light-houses furnished with them, and there is no complaint of their inadequacy to the wants of navigation. On the contrary, the universal testimony is that of unequivocal and decided approbation, and among the witnesses we find the names of two of the most accomplished officers of our own Navy, Lieutenants Blake and Gedney, and a distinguished officer of the topographical corps, Captain W. H. Swift.

Impressed with the deep importance of this subject to the welfare of commerce and the safety of the mariner, we have devoted much time to our own examination of the lights, and having no desire to arrive at one result rather than another, we have been subject to no bias in the investigation; our conclusions must, therefore, be regarded as those of an entirely independent authority, and it will be seen that they do not differ
materially from those of the Bell Rock committee, appointed by the British board of commissioners of Northern light-houses to investigate these lights, and who, under the guidance of Sir David Brewster, devoted three years to this important examination. The executive member of this committee, and the one who arranged all the apparatus, was Robert Stevenson, Esq., whose official prejudices (as chief engineer of the Northern light-houses) were known to be strongly in favor of the old system of reflectors.

Our conclusions are also the same with those of Mr. Alan Stevenson, (who has succeeded his father as chief engineer,) and with those of Captain Drummond, the inventor of the Drummond light, and of Mr. Barlow, and of Fresnel himself.

The advantage of Fresnel lights over the reflectors is obvious and easy to be understood. It consists, primarily and simply, in catching those portions of light which are lost in the system of illumination by reflectors, either because such portions pass too high into the upper regions of the air, or because they pass too low, and strike the earth at a short distance from the light-house. The light which is thus caught is thrown into a direction sufficiently near the horizon to become useful to navigation. The gain over the reflector is precisely similar in character to that of the reflector over the unaided light, and the light of the refractor or lens bears about the same ratio to that of the reflector which that of the reflector bears to the unaided light. Thus, twenty-nine thirtieths of an open light must be lost, and only one-thirtieth would be practically useful to navigation; but the addition of a reflector of the best model and finish reduces the loss to five-sixths of the whole amount of light, and renders one-sixth of the light practically useful. But the substitution of the dioptic apparatus reduces the amount of lost light to one-sixth of the whole amount of light, and renders five-sixths of the light available; in other words, the serviceable portion of the open light is about \(3\frac{1}{3}\) per cent., that of the best reflector is seventeen per cent., and that of the dioptic apparatus is eighty-three per cent. of the whole amount of light generated. This enormous superiority of the dioptic apparatus is its characteristic feature, and constitutes the strong and unanswerable argument in its favor. The dioptic light, under all circumstances, whether exhibited as fixed, revolving, flashing, or intermittent, gives five times the amount of light of the reflector for the same consumption of oil. (See note, next page.)

A secondary consideration, of no little practical importance, is the circumstance that the "fixed" dioptic light is much more perfect than the "fixed" light by reflectors, because its light is diffused equally in every direction. This is not the case with the reflector, for if ten reflectors, for instance, of the best model, are arranged upon a circular stand as a fixed light, each lamp illuminates only a small portion of the horizon in front of its reflector. Hence not more than one lamp (of the ten) can be seen in any direction, and there are large intervals in which no lamp can be seen. The dark spaces are even larger in this case than the illuminated portions, so that only forty-two per cent. of the whole horizon is lighted, and less than twenty per cent. is lighted with the full power of a single lamp. The dioptic light, on the contrary, is seen in
every direction with the same brilliancy. The only objection to the
dioptric light arises from the dependence upon a single lamp, fed by a
mechanical contrivance. Any injury to the valves might extinguish
the lamp, and it would take about twenty minutes to relight it. Ex-
perience seems, however, to have shown that this danger is more specu-
lative than real, for there is no public complaint of any such occurrence,
nor are we informed of its having happened. We are also of opinion
that this danger might be avoided by the substitution of a large fountain
lamp for the mechanical lamp.

Our attention has incidentally been drawn to the great inferiority of
the reflectors generally used upon the American coast, by which the
amount of available light is much less than one-half of that which
would be given by a good reflector of suitable dimensions. The gain of
the dioptric light over such a reflector cannot be less than in the ratio
of ten to one. Hence it is that Mr. Lewis has been able to exhibit the
accompanying schedule of our northern lights, in which he fairly pro-
poses to furnish nearly three times the amount of light with only about
one-third of the present consumption of oil. With about 8,800 gal-
loons of oil, he gives nearly three times the amount of light actually
furnished with 26,400 gallons, and as much light as, on the present
wasteful system, would be derived from the consumption of 78,000 gal-
loons of oil. In this proposition there is no mystery or deception, nor
any reasonable room for doubt or distrust. The principles of this gain
are admitted by all scientific men as incontestable, and admit of
being tested by any man of good sense and decent acquirements.

We cannot close this report without expressing our deep sense of Mr.
Lewis's thorough acquaintance with the whole subject of light-houses,
both theoretically and practically—of his openness and candor in every
point of the investigation, and his anxious desire to aid us in arriving
at the truth.

Most respectfully, your obedient servants,

BENJAMIN PIERCE.
JOSEPH LOVERING.

HARVARD UNIVERSITY, February 8, 1846.

NOTE TO REPORT.—This paper gives the result of our experiments,
made for determining the comparative value of the catoptric and diopt-
ric methods employed in light-houses.

These experiments were carefully conducted, without any bias, and
with no desire but to find the truth.

The apparatus was furnished by Mr. J. W. P. Lewis, and arranged by
him in working order, in the spacious hall over the new depot of the
Boston and Maine railroad.

Our plan has been to compare the reflector with a Carcel flame
placed at a given height, and then compare the Carcel flame with the
dioptric light. When possible the catoptric and dioptric lights have
been brought into direct comparison as a kind of verification of the
first result.

Although the number of our experiments has not been very great, we
place considerable confidence in our conclusions, from the time and at-
tention bestowed upon them, and a satisfactory correspondence between them and those which have been reached by men who have more fully investigated the subject in Great Britain.

Our examination extended to the following articles of the apparatus, viz:
1. An annular lens of the first order, with lamp of four wicks.
2. An annular lens of the second order, with lamp of three wicks.
3. A cylindric refractor of the third order, with lamp of two wicks.
4. The same varied by flashes.
5. A catadioptric series of the third order, small model, with an Argand lamp.
6. The same varied by flashes.
7. A catadioptric series of the fourth order, with an Argand lamp.
8. The same varied by flashes.
9. A parabolic reflector of silver plate, 21 inches in diameter, and 4 inches local axis, lighted with an American light-house lamp, with three-quarter inch burner.

Our results are as follows:
1. The annular lens of the first order is equal to the combined effect of nineteen such reflectors as are specified in No 9 of the above enumeration. Its lamp consumes as much oil as nineteen of the Argand burners of three-quarter inch diameter, which are used in American reflectors.
2. The annular lens of the second order is equal to twelve of these reflectors. Its lamp consumes as much oil as thirteen of the above three-quarter inch Argands, which are used in American reflectors.
3. The cylindric refractor of the third order, used as a fixed light, spreads a uniform light in every direction equal to fifty-seven per cent. of the maximum effect of the above reflector in its best direction. Its lamp burns as much oil as six of the above three-quarter inch Argand burners.
4. This cylindric refractor is varied by flashes, so as to send a flash ten per cent. more powerful than the maximum flash from one of the above reflectors.
5. The catadioptric series of the third order, (small size,) shown as a fixed light, spreads a uniform light in all directions equal to twenty-five per cent. of the maximum effect of the above reflector. Its lamp burns as much oil as 2\% of the above three-quarter inch Argands.
6. This catadioptric series, varied by flashes, gives a flash three per cent. stronger than the brightest light from one of the above reflectors.
7. The catadioptric series of the fourth order, shown as a fixed light, spreads a uniform light in all directions equal to twelve per cent. of the maximum light which goes in the best direction from one of the above reflectors. Its lamp burns as much oil as 1\% of the above three-quarter inch Argands.
8. This catadioptric series, varied by flashes, gives a flash seventy-eight per cent. as great as the maximum light that goes from one of the above reflectors.
9. The above-named 21-inch reflector projects a beam of light equal, in its best direction, to one hundred and ninety Argand burners of one
inch diameter, with a flame 1 ½ inch high. This maximum power is con-
fined to about three and a half degrees on each side of the axis. Its power
is reduced, at the distance of seven and a half degrees from the axis, to
twelve such Argand burners; accordingly the valuable light from such a
reflector is confined to a range of about five degrees on each side of the
axis. The mean effect of such a reflector, if averaged over a range of
seven and a half degrees each side of the axis, is equal to one hundred
and twenty of such Argand burners.

BENJAMIN PIERCE.
JOSEPH LOVERING.

Note 5.—Report to the British Parliament, 1845, before cited.
See the appendix to the report of 1845, to the British Parliament, be-
fore cited. Memorandum by Mr. Alan Stevenson. Also the notes on
the illumination of light-houses, by the same writer, before cited, con-
taining the results of experiments on the loss of light by reflection, and
the transmission of light by the dioptric lenses and the catadioptric
ring.

Notes 6, 7, 8, 9, and 10.—See the Senate document No. 488, 28th
Congress, first session. Also the letter of Leonor Fresnel, before
 cited. Also the Annuaire, by Arago, before cited. Also the report to
the British Parliament, before cited. Also report of Mr. I. W. P. Lewis,
before cited. Also report of the committee of the Royal Society of
Edinburgh, before cited. Also art. 13, vol. 127, p 211, of the philo-
sophical transactions of the Royal Society of London, for 1837, “on the
adaptation of the different modes of illuminating light-houses," &c. In
this paper, the relative effect of varying the size of the reflectors and
lamps is discussed.

See also Edinburgh Review, vol. ivii, for 1833, art. 8, page 169, “on
the construction of Polyzonal lenses and mirrors of great magnitude,
for light-houses," &c., by David Brewster, LL. D., F. R. S. Also Ed-
inburgh Philosophical Journal. vol. viii, p. 160, for 1823; “Account of
a new system of illumination for light-houses,” by the same author; Ed-
inburgh, 1827. Also Edinburgh Review, vol. lxii, 1835, art. 13, 221,
by the same. Also the communication from Messrs. E. & G. W. Blunt,
of New York, before cited. (Docs. 258 and 738, 25th Congress, second
session.) To the zeal and intelligence of these gentlemen, the United
States are indebted for the introduction of the Fresnel system at the
Navesink station, near New York.

A lenticular fixed light is to be erected on the Brandywine shoals, in
Delaware bay, on a screw-pile light-house. Another, a fixed and flash-
ing light, with the latest improvements, is to be erected on an iron light-
house on Carysfort reef, Florida, (on piles of iron inserted into the rock
of the reef.) Another has (the committee have been informed) been or-
dered of a singular pattern, which may be described hereafter. The
lenticular light, (so called,) on the Battery of New York, does not per-
tain to the Fresnel system, and needs, at present, no further notice.

The documents relating to light-houses, published by Congress, before
cited, may be consulted for such defence as has been essayed of the sys-
tem and practice pursued in the United States.
The committee might cite many additional authorities, but their space is limited. They have, moreover, confined their references to the sources of information which are readily accessible to the citizens of this country.

It will be gratifying intelligence to all who take any interest in the advancement of light-house engineering and illumination in this country, to know that the report of the Light-house Board, appointed many months since to investigate the light-house system of the United States and other nations, is now being distributed among the members of Congress.

The report, as made up by the Board, was sent in on the first of February last, consequently more than four months have been consumed in the business of printing. What a strange contrast this, with the manner printing is done in the Empire city. It is high time there should be a corrective to the abuses and delays in the prosecution of the public business.

The report is very voluminous, embracing 740 pages, and many valuable drawings and engravings. Nothing of like importance relative to our light-house system, has ever been originated in the United States before. And the gentlemen who have contributed so much to advance the commercial interests of this country, are entitled to the thanks of the whole community. They have made it a matter of duty to carefully investigate the subject, and have submitted a plain, unvarnished tale, which cannot fail to strike every unbiased and thinking mind with a certain conviction that the present system of light-house illumination, &c., as employed in the United States, is inferior to that of any other country on the face of the globe. It is said by the Fifth Auditor, Mr. Pleasonton, who has had the sole charge of the light-house direction in the United States for nearly forty years, and who claims to be rather the father of the system, that the lights of the coast of the United States are in better condition than ever before, and entirely satisfactory to pilots, shipmasters, &c. The Light-house Board are therefore charged with having arrived at erroneous conclusions regarding the Light-house Department. It is probably true that the lights on our coast are better kept now than formerly; but does this argue that they are equal to the lights on the coasts of England, Ireland or France? And who are we to believe in this matter—those who have examined the lights in the several countries alluded to, and who are practically qualified to judge in everything pertaining thereto, and who, moreover, have no self interest in the matter, or those who have never seen any lights except those on our own coast, and who have a personal interest in the present system? This is a matter which interests every person in society, for all have friends who are to be benefited by such means of protection. With our fast-increasing commerce, and a coast washed by the stormy elements of two oceans, may we not ask that the mariner shall have at least equal protection here as is afforded him in England, Ireland, or France? This subject has heretofore been lost sight of, in the great vortex of political
strife which so absorbs the attention of our national councils; and the system established forty years ago, has been suffered to exist as a fixture for all coming time. Should the community be asked to go back to the old style of lamps made use of when our fathers lived, we should be told that improvements had been made in illuminating apparatus since then, and philosophy had not been idle in its endeavors to enlighten the habitations as well as the mind of man. All know of such improvements, and the case needs no argument. Now here comes a case where millions of lives and endless millions of property, are made dependent, in a great measure, upon the light-houses and light-ships on our coasts; and shall not reason be allowed to hold its sway in perfecting and improving this department of illumination? or shall it be said that America cares more for politics than she does for life? This is a momentous subject, and one which should engage the attention of our statesmen in Congress and out of Congress. By the present laws and regulations, the Fifth Auditor is delegated with the general management of the Light-house Department, under the Secretary of the Treasury, and the collectors of customs at the several ports and districts in the United States, are, by virtue of their office, delegated with the management of the light-houses at such places, and are therefore superintendents for such districts. Now all know that the office of collectorship is invariably a political appointment, and though the incumbents are usually very excellent business men, they know comparatively nothing about light-houses. And why should they? They certainly, in a majority of cases, have had no opportunity to qualify themselves in this important branch of science. All other countries have a Light-house Board, or Trinity, of eminent scientific men, whose duty is to manage this entire branch of business, and it is now proposed that the United States should establish a board of this character, simply calling into such service men of science from the navy, army, and coast survey, without altering their present salaries, or increasing the annual expenses thereby, while the disbursements are to be made through the Secretary of the Treasury and collectors, as now. The report which is now submitted to the American Congress, and through them to the people of the United States, is a volume of interest, and should carry conviction into the minds of those who have heretofore been skeptical on the subject.

Report of the Secretary of War, communicating, in compliance with a resolution of the Senate, a report in relation to the construction of a light-house on the New South Shool off Nantucket.

APRIL 19, 1852.—Read, and ordered to lie on the table.
MARCH 23, 1853.—Ordered to be printed.
APRIL 4, 1853.—Ordered that 100 additional copies be printed for Major Bache.

WAR DEPARTMENT,
Washington, April 15, 1852.

SIR: In compliance with the resolution of the Senate of the 22d ultimo, I have the honor to transmit, herewith, a report of the colonel of the corps of topographical engineers, containing "the report, esti-
mate, and plan, in reference to the beacon or light-house structure for the New South Shoal off Nantucket," called for by the resolution.

Very respectfully, your obedient servant,

C. M. CONRAD,
Secretary of War.

Hon. Wm. R. King,
President of the Senate.

BUREAU OF TOPOGRAPHICAL ENGINEERS,
Washington, April 14, 1852.

SIR: In obedience to a resolution of the Senate of the 22d ult., I have the honor to submit the report, plan, and estimate in reference to a beacon or light-house upon the New South Shoal off Nantucket.

The law on this subject is dated 2d March, 1849, and is in the following words: "For a screw-pile beacon or other practicable structure on the South shoal off Nantucket, lately discovered by the survey of the coast, twenty-five thousand dollars, to be expended under the direction of the Bureau of Topographical Engineers."

This shoal—called Davis's shoal, after the officer of the Navy who made the discovery and the survey—lies about twenty miles from land, in the broad ocean. I do not know on whose plan or estimate the appropriation was based; but being satisfied that it was utterly impracticable to erect any durable and useful structure of the kind indicated in the law for the amount appropriated at such a locality, the bureau has limited its efforts to an investigation of the subject, and to the preparation of plan and estimate. Major Bache was assigned to those duties, and the report now submitted is from him. With his report are numerous and well-executed drawings of his plan, and of its details, and also a model, all of which are now in this office.

With the report are sent such of the drawings and charts as he has indicated as necessary to illustrate the views and reasoning of his report.

The direction of the law being "for a screw-pile beacon or other practicable structure," it left the engineer free to the exercise of his knowledge and ingenuity, within the only limits prescribed to him by this office—namely, a beacon or a light-house.

From the estimates submitted, in accordance with the plan which here commends, it will appear that the estimate for the light-house is $322,786 79

For the beacon........................................... 234,664 73

And that, for the operations of the first season there will be required, in the first case.......................... 190,589 20

And in the second........................................ 157,530 21

These facts will, I hope, satisfy Congress that the course of the bureau, in reference to this appropriation, has been judicious.

The report of Major Bache exhibits with much force the necessity of some such structure as he recommends upon that shoal, and the bureau
is clearly of the opinion that it should be a light-house, in preference to
a beacon.

Respectfully, sir, your obedient servant,

J. J. ABERT,
Colonel, Corps Topographical Engineers.

Hon. C. M. CONRAD,
Secretary of War.

P. S.—Of the appropriation of $25,000 herein referred to, there has
been drawn from the treasury, for the purposes stated in this report, no
more than $2,750.

OFFICE OF NEW SOUTH SHOAL BEACON,
Philadelphia, December 27, 1851.

SIR: I have the honor to present the following report, accompanied
by plans and estimates, on a beacon for New South shoal, off Nantucket.

The group known as the Nantucket shoals extends off seaward, from
the island of that name, six to twenty miles, between an E. line drawn
from “Great Point,” and a SSE. line drawn from “Tom Never’s Head.”
It comprises “Old Man’s,” “Pochick Rip,” “Bass Rip,” “Point Rip,”
and “Old South” and “New (Davis’s) South” shoals, besides about
forty smaller shoals and shoal spots, single and in clusters, without
names, laid down for the first time, within the last few years, by the
Coast Survey. These shoals, composed of hard sand, with depths from
six to eighteen feet at low water, form an aggregate of about twelve
square miles, and are scattered over an area of at least 375 square miles, or
in the proportion of 1 to 30 nearly; the soundings between them varying
from 3 to 18 fathoms. The direction of the currents through the group
is entirely round the compass every successive ebb and flood, one-half
being occupied by the four “quarters” of the two tides; the flood, the
eastern quadrant, from NE. the first, to SE. the last quarter, veering
round to the east by the south; the ebb, the western quadrant, from
SW. the first, to NW. the last quarter, veering round to the east by the
north. Their greatest velocity is 2½ miles; their least rarely less than half
a mile, even at the period known in most other localities as “slack-
water,” and sometimes at that stage of the tide it exceeds a mile. These
velocities increase greatly over the shoals, and with their courses are
subject, as elsewhere, to be modified by the direction and strength of the
winds. The rise and fall of the tide is 3 feet 2 inches; the extreme
rise, 6 feet 9 inches. In common with all parts of the eastern coast
the entire group is enveloped for many days at a time by dense fogs.

The shoals lying seaward of the island, itself separated by a channel
of twenty-five miles from the main land, which there projects beyond
the general line, form the most salient point of the coast, north and east
of Cape Florida. The course from Sandy Hook to the seaward face of
the group is about E. 3 N., and thence due north, or nearly at a right
angle to the mouth of Kennebec river; a line drawn between the same
points, N.E. by N., and cutting across the land, leaving the outer shoal nearly 140 miles seaward. The coast south of Sandy Hook trending less to the westward, the courses from the capes of the Delaware and Chesapeake incline more to the north, and hence lines from those points to the Kennebec cut off, seaward, correspondingly less of the land.

The foregoing account of the character of the bottom; the limited depth of water over the shoals, their number and small size compared with the large area in part out of sight of land, throughout which they are scattered in deep water; the great velocity and ever-changing direction of the currents, in every instance running across the shoals; and the prevailing fogs, coupled with the prominent position of the group, will show at the same time the important relation which these shoals hold to the course of a large portion of the commerce of the country; the great danger to which it is exposed in passing them; the necessity for marking at all times their seaward face, and the extraordinary difficulties which lie in the way of accomplishing so desirable an object. The value of such an aid to navigation can hardly be exaggerated. The advantages flowing from it would certainly not be inferior to those resulting from the marking of any other point of the extended line of the Atlantic coast. What now constitutes a danger and a dread to navigators, and consequently a positive injury to commerce, would in that event become a means of safety, and benefit it. Forming the great point of departure and arrival for that part of the coast, vessels, particularly those engaged in foreign commerce, would no longer approach the shoals under reduced sail or steam, but stand boldly on, and, having made the light, continue confidently on their course for their ports of destination.

The commerce most interested in the proposed measure consists of—

1. The British American and European trades, from all ports south of Nantucket, as far at least as the Chesapeake, and of all other foreign trades from ports north and east of the island;

2. The whale trade, the ports of which are principally in Martha's Vineyard and Nantucket, or on the main in the vicinity of those islands; and,

3. The coastwise trade between ports on either side of Nantucket.

The magnitude and value of the commerce under the first head, and the number of persons connected with it, either as seamen or passengers, will be seen from statement No. 1, appended hereto, condensed from statements A, B, C, D, also appended. It is confined, as sufficient for the present purpose, to the principal ports of New York, Philadelphia, and Baltimore, within the first geographical limits, and Boston, Salem, Portland, Bath, and Eastport, within the second, and shows a grand aggregate of 6,177 sea going vessels of all classes, valued, with their cargoes, at $252,345,286, and paying in duties $26,988,054, and carrying, without taking into account outward-bound passengers, of whom no record is made, 285,558 persons, as passing the shoal in a single year. To what extent the trade of the remaining thirty-two ports within the first, and the twenty-one ports within the second division, as given above, would increase these amounts, can only be surmised in the absence of
the records of the respective custom-houses. That these records would increase them considerably, there can be no doubt.

The extent to which the whale trade is interested in pointing out the position of these shoals, can only be determined with anything like accuracy by tracing the course of each vessel engaged in it, to and from her port. In the absence of this information, it is only necessary to know that this trade is carried on from ports on either side and in the immediate vicinity of the group, to be convinced that it is largely interested in the measure. Thus, of the 606 vessels engaged in this trade, 475 arrive at and depart from their ports by the passage east of Long Island, barely 50 miles wide, and distant at the nearest point not more than 30 miles from the group; 69 belong to Martha's Vineyard and Nantucket, or on the main, back of those islands, which, whether inward or outward-bound, are exposed to the shoals; and the remainder, or 62 vessels, are from ports north and east of Cape Cod, which, as the fishing grounds are principally south and in the Pacific, must pass them both going and returning. The relation which the position of the Nantucket shoals has to the usual course of the whale trade being thus shown, it is only necessary to examine the statements herewith, numbered 2 and 3, to see the interest which that most valuable trade has in the consummation of the proposed project. The first gives the entire whaling fleet, on the 9th of September last, as consisting of 606 vessels of all classes, with crews numbering 14,538 men and boys, and having a tonnage of 189,622 tons, valued at $7,584,850. The second, the arrivals of the trade for 1851, footed up as follows: vessels of the four classes, 239; crews, men and boys, 5,559; value of vessels $2,929,340, and value of "catch" $10,238,784, and total value of vessels and "catch" $13,178,124. That is to say, assuming the correctness of the premises as stated above, the inward-bound fleet of the whale trade, having a value of $13,178,124, and manned by crews numbering 5,559, is exposed in a single year to the dangers of these shoals. But this exposure is not confined to the inward-bound trade alone; the outward-bound trade should also be considered. A statement of this trade is not within reach, nor is it absolutely necessary for the purpose of this report; for assuming, as is reasonable, that to keep up the whaling fleet on the fishing grounds, the departures hence must compensate for the arrivals home, a sufficiently near result may be come at by taking the totals under the different heads in the statement No. 2, omitting that under the head of the value of the cargo or "catch." With this reduction, the footings of the outward-bound whaling fleet per annum will stand thus: number of vessels 239; number of the crews, 5,559; and value of vessels, $2,929,340. For want of reliable data, no note is made of the cost of outfit of the vessels—an item that would add very considerably to the value of this trade.

As the coastwise trade passes for the most part through the Sound, between the island of Nantucket and the main land, that trade is comparatively but slightly interested in the proposed project. Whatever exceptions there may be to its usual course, are probably confined to vessels trading between ports north and east of the island and the dis-
tant domestic ports of the Gulf of Mexico and the Pacific; and to ves-
sels which, wind-bound by the channel through the Sound, take the
risks of the outside passage. It may, however, be confidently assumed
that if the outer point of the Nantucket group were at all times dis-
tinctly marked, these exceptions would increase, as a consequence of
affording greater facilities to this valuable and growing branch of com-
merce. Of the extraordinary number of the vessels engaged in this
trade which pass Nantucket island, either by the Sound or seaward, some
conception may be formed (in the absence of a true record, which can
only be obtained by a laborious search through the “Commercial Lists”
of the day) from the fact that during the year ending the 30th of June
last, there were seen to pass the “Cross Rip” light-boat, stationed in
Vineyard sound, some 12 or 15 miles northwesterly from Great Point
Nantucket, no less than 44,431 vessels of the four classes; a record, let
it be remarked, that, in consequence of fogs and the absence of a rigid
look-out, must fall far short of the actual number that passed that
station.

Confining the value, &c., of the commerce to the authentic state-
ments under the first two heads—that is, to those having reference to
the foreign and whale trades—it appears that 6,655 vessels of all classes,
carrying in crews and passengers 296,676 persons, and valued with
their cargoes at $268,452,750, and paying in duties $26,988,054, (being
more than one-half the entire revenue of the country from this source,)
pass and are exposed to loss by these shoals in a single year. If to
these results were added the number of vessels, with their value and
the value of their cargoes, and number of persons, of the foreign trades
from the 53 inferior ports already referred to, and from ports south of
the Chesapeake, as far as Cape Florida, and of that portion of the
coastwise trade which takes the outside passage at Nantucket; and were
also added the value of the precious metals and the number of outward-
bound passengers of the foreign trade—the principal statistics of which
have been given—it is not unreasonable to believe that a grand aggre-
gate would be shown to prove that property of the value of a million of
dollars, and lives to the number of one thousand, are put in jeopardy
every day throughout the year by these dangerous shoals.

The foregoing statements and remarks give a general idea of the
great importance to commerce of pointing out, at all times, the seaward
verge of the Nantucket group of shoals. In other points of view, the
subject presents itself in a manner, if possible, still more striking.
Between the port of New York alone and Europe, there are, at this
time, four lines of steamers. Some of these steamers cost, “all told,”
to put to sea, about $233 per ton; or, for one of the largest, say,
$675,000. By the present schedule of sailing, the four lines make
altogether 136 trips annually, passing, of course, the Nantucket shoals
as often, or at the rate of one steamer for little over every two and a
half days throughout the entire year. The cargoes of these vessels
hence for Europe—being made up, for the most part, of the bulky pro-
ducts of the country—are not, (if the precious metals, of which they
carried in the year 1851 $43,673,209, be left out of the account,) com-
paratively, very valuable. On the other hand, those of the inward-
bound steamers, consisting mainly, as they do, of the most costly manufactured goods, are generally of great value. This value seldom falls below a quarter of a million of dollars, and at times rises above a million of dollars; and, if the newspaper accounts may be relied upon, in one instance actually amounted to double that sum. As a general rule, it may be assumed that the cargoes of more than one-third of the arrivals are worth over half a million of dollars. From this account it will not be deemed extravagant to set down these vessels, with their cargoes, taking the inward and outward trips, at a value bordering closely on a million of dollars; the destruction of any one of which, if of the American lines, would cause a loss of a like sum to the wealth of the country at large. Again: of the 136 trips in 1851, 67 were homeward passages, at the close of each of which large sums were paid in the form of duties into the treasury. These duties—as often, probably above as below one hundred thousand dollars—on two occasions, being those on the arrival of the Franklin, from Havre, in January and July, actually reached the enormous sums of $311,378 50 and $329,070 80, respectively. Thus it appears that, besides the very heavy loss the wreck of any of these steamers would cause the country, the receipts of the treasury would be seriously affected; in two instances to an amount, that, if the measure be at all practicable, would probably point out for all time the position of these dangerous shoals.

To the trade under the first head, the project in hand is of more importance, as involving larger interests than that under either of the other two, and to all of more value in regard to the homeward than to the outward-bound trade. The ratio of equality in the dangers which at present exist between the inward and outward-bound trades, so far as these dangers arise from the Nantucket shoals, is owing, it will be remarked, not so much to the intrinsic difficulties of the navigation of the latter, (unless, indeed, there are unknown currents in their vicinity, or erroneous estimates of the direction and velocity of those that are known,) as to the absence of proper caution in that trade in making an offering. The striking of the steamship United States, on her last voyage to Europe, and the total loss, with her crew, during last winter, of the ship Ivanhoe, on these shoals, within little more than twenty-four hours' run from their port of departure, New York, would, no doubt, were the circumstances attending these disasters known, prove the correctness of this opinion; and of which the statistics of the losses generally of the outward-bound trade, could they be got at, would probably be a further confirmation. But of all the homeward-bound commerce, to that from European ports is the marking of these shoals a measure of the greatest importance. Fully to understand why this must be the case, it is only necessary to state that the usual course of this most valuable trade is to make Cape Race, the eastern point of Newfoundland, and then run down the coast inside the Gulf stream, which, by the jutting out into the ocean of Nantucket and its shoals, here approaches nearest the land. The passing of the shoals is hence a proceeding of great peril, causing a corresponding anxiety to all who are engaged in this trade. Nor are the peril and anxiety confined to the navigators of sailing vessels; they are largely shared, notwithstanding the more perfect means by "dead-
reckoning," in the absence of the usual "observations," to determine a vessel's position, by those in charge of steamers, more than one of which, in the short period this class of vessels has been employed in trans-Atlantic navigation, have been involved in the intricacies and dangers of these shoals.

The foregoing remarks upon the value of the commerce and the dangers of the navigation described, sufficiently manifest, it is hoped, the great importance of the contemplated project. They might be readily extended and supported by further statistics, not only of the commerce proper, but of the losses of property and life. But this more properly belongs to the legislator than to the engineer, whose province it is rather to show in what way, and at what cost, the work in hand, so essential to the safety of trade and of human life, may be accomplished.

New South shoal is the most seaward shoal of the Nantucket group. It lies out of sight of land, S. by E. ½ E., broad off from the island of the same name, twenty miles distant. It is composed of fine white sand, quite hard and compact; the least depth of water on it at mean low water being eight feet. The mound is stable, though no doubt subject to superficial variations, as all such alluvial formations are, particularly in situations exposed to the extremes of weather. The extent of the shoal within the two-fathom curve is one and a half mile, by a mean width of about one-eighth of a mile; and within the three-fathom curve two and one-twelfth miles, by seven-twelths of a mile. The shoal falls off rapidly into deep water on all sides, particularly seaward, in which direction the soundings, in a distance of a mile and a half, increase to fifteen fathoms. As its general course is east and west, the currents, as already described, necessarily run most frequently more or less across it. It is exposed on the land side from north (Cape Cod) to west (Montauk point) or throughout one-fourth of the circle, to a sweep of the sea varying from twenty miles to one hundred miles; and from the north, round by the east and south, to the west, or for the remaining three-fourths of the circle, from one hundred miles to the extreme reach of the broad Atlantic. The nearest harbors to the shoal by a steam line are Nantucket, 40 miles, Edgartown, 42 miles, and Holmes's Hole, 46½ miles.

There is no reason to suppose that New South shoal is of recent origin. Like all the shoals forming the extensive group known as "the Nantucket shoals," it is the result of causes which have been in operation from a remote period. Whatever difference in age, if any, exists between it and the other shoals of the group, is wholly due to its greater distance from the land. That it has until late years been confounded with "Old South shoal," is highly probable. Their size and depth of water, and comparatively near proximity, but, above all, the ever-varying direction of the currents in the vicinage of the shoals, and their positions out of sight of land, would seem to favor the correctness of this opinion. What previously was considered as one and the same shoal, has by the Coast Survey been found to consist of two distinct shoals; a result no less creditable or important from the labors of that great national work, than the discovery and marking of a new shoal.

It is doubtful whether, when its true character is reflected upon, and
especially the exposure of the position, the depth of water and nature of the soil at the site, and its distance from land and a harbor, any project in the whole range of maritime construction has ever been entertained which presented so many difficulties in the way of its accomplishment, as the one under consideration. Such was my first impression, when, with only a general knowledge of the circumstances involved in the measure, the bureau thought proper to direct my attention to it; but my early impressions gradually became a settled conviction, under the influence of facts newly developed, investigations anxiously made, and reflections consequently arising. While under such a persuasion, therefore, it would be affectation on my part, if I were to pretend that I feel no diffidence of my ability to solve so difficult a problem. If I may not recommend the true course to be pursued for consummating so great and important an undertaking, it will be truly regretted by me; but I shall have the satisfaction to know that I engaged in the task with a due sense of my obligations, and a single and earnest desire to do so, free from all bias for or against any particular system of construction.

Instances are not wanting of works founded at positions exposed to the extreme violence of the ocean, which have triumphantly defied its power; and among them may be especially mentioned the Eddystone, Bell Rock, and Skerryvore light-houses. But in all these instances the conditions under which the structures were raised, were widely different from those of the project which is the subject of this report. Those structures were founded upon rock, always or at times exposed above the level of the sea; they were less distant from land and a harbor, and open to the sweep of the ocean through a smaller arc. In these observations, far am I from desiring to undervalue the genius which designed, or the indomitable energy and perseverance which successfully raised these renowned works. My desire is rather to express more emphatically my appreciation of the serious difficulties and hazards which are to be encountered in carrying out the project under consideration. The accompanying statement, made in the form of a table, will exhibit at a glance the "conditions" of each of the three positions or works just named, side by side, as compared with New South shoal; extended, for future reference, to the cost and the time consumed in the erection of each work, those for the latter being, of course, only estimated.

No work of a solid character placed on a submerged sand at so exposed a point as New South shoal, were it possible to found one, could long withstand the power of the ocean. That it would not be overthrown by the direct blow of the waves, the successful resistance of the works just named, at points where the inclination of the bottom and the depth of water are calculated to give greater force to the waves, prove beyond all reasonable doubt; but that its destruction would nevertheless be inevitable, from the rapid and ceaseless process of the wasting of the sands of the shoal, caused by the recoil of the sea from the mass, is no less certain. To provide a base of sufficient size and strength to sustain the necessary superstructure, that shall at the same time offer no very sensible obstruction to the free passage of the currents and the waves, is the great desideratum in founding works on sub-
merged soils exposed to the batter of the ocean. This desideratum the last few years has supplied in the screw-pile of Mr. Alexander Mitchell, of Belfast, and in the pneumatic pile of the late Dr. Lawrence Holker Potts, of London. The next inquiry in order is, whether either of these modes is applicable to the site at New South shoal. After much reflection, aided in no small degree by the experience acquired in the erection of the light-house on the Brandywine, I am of opinion that the first, being the method of screw piles, cannot be employed to found a work at that point, and for these reasons:

1. That the screws could not be made to penetrate the shoal to the required depth, by any means applied from a floating body, moored in the tide and sea-way at the point in question.

2. That it is not possible to erect a temporary fixed structure during the working season at so exposed a point, at least in time to be available for driving the screw piles; and,

3. That if it were possible to raise such a structure in time, it is doubted whether any power applied from it could insert the piles to the necessary depth, into a sand so hard and compact.

The screw pile has been successfully applied in forming foundations of light-houses on the Maplin sands, mouth of the Thames; on the North Wharf sands, mouth of the Wyre; on the shoal ground off Holywood, Belfast bay; and, in this country, on Brandywine shoal, mouth of Delaware bay. The attempt to erect a light-house on the north end of the Kish bank, in St. George's channel, by means of these piles, failed, from no defect in the principle claimed for these useful appliances in forming submarine foundations, but principally, as it is understood, from the coming up of a heavy gale from the southeast before the piles were properly braced, and the diagonal stays attached. The design to raise a beacon of screw piles on the eastern end of the Tongue bank also proved abortive; but, as in the case of the structure on the Kish bank, from no inherent defect in the piles themselves. This beacon was composed of five six-inch piles, and raised in position by the Trinity House. Shortly after it was put up, it was discovered that an accident had happened to it, and, on examination it was ascertained that three of the piles were broken off short, and the other two bent. The stumps of the broken piles, and the lower parts of the bent piles, were found perfectly upright, and the sand around them undisturbed; showing the structure failed from no fault of the hold they had taken of the ground. Their condition indeed affords the best evidence of the capacity of the screw pile on this point, as it appears the force that was sufficient to break off three and bend two wrought-iron piles of the size stated, was, at the same time, unequal to the task either of uprooting them or even changing their position in the bottom. As the force of the waves, acting on such small surfaces as these piles presented, was entirely inadequate to produce the effects described, the destruction of the beacon was sought for in other causes. The conclusion arrived at, at the time, and no doubt the correct one, was, that a vessel had passed over it; a conclusion in a measure confirmed by finding the copper of a vessel attached to the top of one of the bent piles. It may be remarked here, incidentally, that accidents from this cause
form the only real objection, save the destructible character of the material, either to the screw pile or the pneumatic pile, and only then of works founded in navigable depths.

In every one of the instances cited of these constructions in England and Ireland, rafts or pontons, or boats built expressly for the purpose, were used to receive the power employed to drive the screws. But the circumstances under which this operation was carried on were, in every case, widely different from those which would control it at New South shoal. In no instance was the exposure as great, and in three much less, and in all the soil afforded greater facilities for penetration. An account of the several localities in question, so far, at least, as to include the characteristics which govern in such operations, compared with that already given of New South shoal, will at once make this manifest.

The Maplin is on the west Swin channel, at the southeast point of the shoal ground known under that name, and about 4½ miles from the shore, where the Thames expands to a width of 20 miles. The site is bare at the lowest water of spring tides, and the "sand of the bank of an exceedingly soft nature." The soft character of the soil is very evident from the fact stated in the account of the erection of the lighthouse, that the nine piles, with screws as large as 4 feet in diameter, forming the base of the structure, were driven into the bottom, from a raft, by 30 men, to a depth of 22 feet, in the short period of 9 days. The Wyre light is also situated on a low-water bank connected with the land, from which it is but 1½ mile distant. Though open towards the sea for a considerable arc, it is protected from its roll by large areas of shoal-ground, which lie off in that direction. One account states that "the bank was found to be sand, but of a much harder description than at the Maplin," and that the screws of three feet were "sunk 13 feet into the bank;" another, that the entire penetration was but 10 feet; the first 7½ feet being sand, the rest marl. It is scarcely necessary to remark that a soil may be "much harder" than one described as "exceedingly soft," and yet may not be very hard. The light off Holywood is in 10 feet at low tide, within a quarter of a mile of a low-water point, and less than a mile of the shore off Belfast bay, where it is little over two miles in width; a position, certainly, of no great exposure. The soil is described as "hard sand and gravel for 7 or 8 feet, then soft tenacious clay." The screws employed were 3½ feet in diameter; but how far they were entered into the bottom the published accounts, as far as these have been met with, do not state. Materials uniform in size and homogeneous in character, form the most compact and impenetrable bodies. This is seen on a large scale in the greater stability of the sea slopes of breakwaters, formed of masses of stone of a uniform size, over those composed of stones of different sizes, and in the greater firmness of the road bed of McAdam, of which it is the leading principle, compared with the roads previously made. The same rule applies in a measure also to soils, and will afford the best criterion by which to judge of the facility these screws, or indeed any other form of body, may be thrust into them. Had that composing the site off Holywood been all of sand, or all of gravel of uniform or nearly
uniform size, the penetration by the screw would no doubt have called for a much greater power than it is understood was used on that occasion, or, what is the same thing, the same power, if applied afloat, applied from a fixed basis. As it was, the separation of the larger bodies by the smaller ones afforded facilities, by the latter acting as so many minute rollers on the former, not only to enter the screws into the soil, but also to accelerate their descent to the depth required. The Kish Bank, at the site of the light that was proposed to mark its northern end, is about 11 miles from the main land, with a depth of 13½ feet at low water, and a rise of tide of 13 feet. The bottom is represented as consisting of "sand of an exceedingly hard and dense description." The screws were intended to be planted 12 or 13 feet in the bottom, but it was found impracticable, with the means employed, to penetrate the bank to a greater depth than 9 feet. The Tongue Bank, or Sand, is at the mouth of the Thames estuary, and hence more exposed than the Maplin, which, besides having the protection of a greater extent of shoal ground seaward, is some few miles further removed from the ocean. The position selected for the proposed beacon was on the eastern end of the bank, in 17 feet water, (another account says 9 feet) with a rise of tide of 15 feet. The screws, which were but two feet in diameter, it is stated, were sunk into the soil, described as "ground exceedingly hard," to the depth of 17 feet 9 inches. It will be remarked that the exposure and depth of water in the last two instances are much greater than at the positions first named. How it was possible in these cases to apply an adequate power from a floating body (under the circumstances more difficult to maintain in a given position,) to insert screws of the size used, to the depths stated, in soils such as those described, it is difficult to conceive. The only way to reconcile what otherwise is inexplicable, particularly to those having any experience in such operations, is to take the expressions applied to the soil, as in the case of that of the site of the Wyre light, in a comparative and not a positive sense. This probably is the true explanation, and accounts for whatever success attended the attempts to apply the screw pile at the Kish Bank and the Tongue Sand; an explanation in a measure confirmed by the fact that the piles in the case of the former, though buried up for a depth of 9 feet, could not stand alone, or, in other words, that the soil, under the action of the sea, on even so small a surface as the shaft presented to it, was, from its soft nature, incapable of sustaining them.

It is evident, from these statements, that in all the cases mentioned, the soil, if not absolutely, was comparatively soft, and that this characteristic alone admitted of the employment of floating bodies from which to apply the power in driving the screws. At the Brandywine the employment of the same means would have signally failed. The preliminary examinations of the shoal gave palpable evidence—which, if possible, was more than confirmed by the subsequent operations—that a more stable footing would be required; for, so far from being able, with such means, either to give the piles their proper relative positions, or to sink them to a depth which at that point would have secured the stability of the superstructure, it is doubted, indeed, whether they could
have been inserted far enough to be able to stand alone. If this be
true in regard to the Brandywine, it will hardly be contended that the
application of the same imperfect means would meet with better suc-
cess at New South shoal, where the circumstances (excepting the char-
acter of the bottom, which, judging from the specimens and feel, may
be considered of the same description) of distance from the land and a
harbor, exposure and depth of water, &c., increasing the sum of the
difficulties attending such operations, are greatly exaggerated.

The experience at the Brandywine is alone relied upon in support of
the opinion contained under the second head. The fixed structure or
platform at that point stood 19 feet 9 inches above the shoal, and was
55 feet square, with a projection at one corner, in all forming an area
of 3,587 feet, and consumed 74 days of the working season of that
locality in its construction. At New South shoal a structure of the
same description, large enough for the intended purpose, would have a
floor of about 80 feet square, and an area of 6,400 feet, and would be
elevated 38 feet (as will be shown hereafter) above the bottom—that
is, it would be about double the area and height, and three and a half
times the cubical dimensions, estimated from the surface of the shoal in
each case, of the one on the Brandywine. Whether the time required
for the erection of two structures, of the character of those in question,
would, under like conditions of exposure, &c., be as the areas of the
floors and the heights from the bottom, or as their cubical contents
above that plane, is a question of which the present experience in such
operations affords no satisfactory solution. It is enough, however, for
the present purpose, in the absence of any definite rule on the subject,
to show that—assuming even the most favorable view of the case, and
taking no account of the greater exposure and depth of water, and the
increase of distance from 13 to 42 miles of a harbor of refuge, in the
case of New South shoal, and conceding also that proper skill and due
diligence were exhibited in the operations at the Brandywine—it would
not be possible to raise the required structure at that point within the
season of operations, (limited in that latitude to five months, from May
to September inclusive, or 153 days,) and leave sufficient time either to
perform the final operation of inserting the screw piles, or to make up
losses of time contingent upon all similar undertakings exposed to delays
from vicissitudes of weather.

Neither is it probable, as stated under the third head, that recourse
to a fixed structure, such as was employed at the Brandywine, were it
possible to erect such a one on New South shoal, would prove success-
ful, except in giving the piles their true relative positions, and this for
the reason of the great elevation above the point of resistance of the
mechanical power, which would be so far spent in the mere torsion of
shafts of so elastica material as wrought iron, of the length required,
as to prove unequal to the due penetration of a sand as hard and dense
as that which is described to be at the point in question. The elevation
at Brandywine shoal was 28 feet 9 inches, made up as follows: 6 feet
for depth of water at lowest spring tides; 7 feet 6 inches for rise of
highest tides observed, (12 feet being the rise of storm tides;) 6 feet
3 inches for height, including 2 feet 3 inches for thickness of platform
above highest tides observed; and, lastly, 4 feet for height of the capstan drumhead, employed to drive the screws, above the floor of the same. It was the original intention to insert the screws in the shoal for a depth of 15 feet; but it was only after the most strenuous exertions, with a force of thirty men working the mechanical power above mentioned, applied to a spur and pinion wheel attached to the shafts of the piles as low down as the water would permit, that they were buried up in the sand for a little more than 10 feet.

At New South shoal the measurements that would go to make up the distance between the point of resistance and the point at which the power is applied, considered with the size of the shaft as the governing condition in the case, are greatly increased, as will be seen from the following statement: The depth at low water, at the point proposed to occupy on the shoal, is 14 feet; the extreme rise of the tide, 8 feet 9 inches. A platform, beyond the reach of the sea, should not be less than 15 feet above the level of the highest water, as the waves, by striking against the many vertical obstructions presented by the wooden piles forming the temporary structure, might, at the limited depth named, be thrown upward against the floor of that platform in such masses as to endanger its safety. Thus, the height of the platform, including 2 feet 3 inches for the thickness, would be 38 feet; add to this 4 feet for the height of the capstan drumhead above the platform, and the whole height is increased to 42 feet, being also the least distance between the points of resistance and application of the power, and, as a consequence, the least length of shaft through which the power to drive the screws must be exerted—a length that would seem sufficient, in view of the experience at the Brandywine, to defeat every effort, notwithstanding the increased size of the shaft to 12 inches, to insert them to a depth to insure the safety of the superstructure.

The pneumatic pile of Dr. Potts is of more recent origin than the screw pile, or, at least, has not been so long known to the public. It has not yet, it is believed, been successfully applied in founding works, such as light-houses, beacons, harbors, &c., exposed to the sweep of the ocean. That it is practically applicable for the purpose, there is every reason to believe. The favorable opinion of those well known in engineering and construction in Great Britain, communicated in the report on the ice harbors of the Delaware, dated the 28th of December last, may be received as conclusive, particularly as it is supported by cases of application already made in other, and in some respects kindred works, on this point. To this testimony and to these cases the bureau is again referred for all the information in possession of this office upon the subject. Of the latter, it is deemed sufficient for the present occasion to recount merely the following instances in which these piles have been used, to show that their size, both length and diameter considered, would seem only limited in their application to the power under the circumstances to handle them. Besides being employed, among other instances, in the founding of the piers of a viaduct in Anglesey over an arm of the sea, the bed of which is of running sand and gravel of great depth; in an experiment on "Grain Spit," to test the powers of the pile to sustain great weights; in the sinking of a pile of large
dimensions in a quicksand in Cornwall; in the construction of a bridge over the Thames at Datchet, and in the foundation of part of a large viaduct on the Holyhead line of railway, a pile of this description, three feet in diameter, has been sunk in the Goodwin sands to the depth of 77 feet, to the chalk formation, and others of the enormous size of 10 feet in diameter, as cofferdams, in the construction of the Midland Great Western railway bridge over the Shannon. To this list may be added the new bridge over the Thames from Putney to Fulham, in which the piers will be formed of four cast-iron cylinders, 8 feet in diameter, carried to such a depth as not to interfere with the dredging of the river. It is proper to remark here that other applications of both the screw pile and pneumatic pile, either in constructions or in experiments, may have been made and noticed in the publications of the day, particularly in periodicals devoted to such and kindred subjects; but as these, in consequence of the restrictions upon the purchase of books, are only occasionally accessible, and then through private sources, nothing is positively known as to the fact.

The objection to screw piles for founding a work at New South shoal does not apply, except as to giving them their true relative positions, to pneumatic piles, which being sunk into the bottom by atmospheric pressure caused by exhausting the air from the hollow shaft, the erection of a fixed structure, such as that required to apply the mechanical power to drive the former, is dispensed with, and the objection to the great length of the pile through which this power must be exerted, at the same time got rid of. But it must not be supposed that because a fixed structure is not indispensable, a floating body is deemed sufficient for the successful application of atmospheric piles in the present instance. This is not the case. That these piles may be planted singly in favorable weather, at so exposed a point as New South shoal, by well-devised measures fully matured, from so unstable a footing as a floating body, the sinking of the cylinder on the Goodwin sands is of itself abundantly sufficient to prove; but that the number of piles required to constitute a foundation for a light-house or beacon may, under the circumstances, be made to receive their proper relative positions, so far at least as to render them properly available for the intended purpose, is not believed. The manner in which it is proposed to provide against this objection in the use of the atmospheric pile in the present case, or at other points of equal exposure, will be explained in the project now submitted.

Having premised that though a solid structure at New South shoal, were it possible to erect one at that exposed point, might withstand the direct assaults of the sea, it nevertheless would be overthrown by the wasting of the sands on which it stands, through the insidious workings of the waves acting on the mass, and that to meet the case, it would be necessary to adopt a foundation which, while it afforded the necessary area and strength to support the required superstructure, would offer no impediment, practically considered, to the motion of the currents or the waves; having also expressed the opinion that works combining these prerequisites may be founded on submerged soils by means of Mitchell's screw pile and Potts' pneumatic pile—and further, that, for
reasons which it is conceived are indisputable, the former cannot be applied to that use at New South shoal—the bureau will already be prepared to learn that, as the practical application of the latter is not open to the same objections, it is recommended for the present design.

The instructions of the bureau calling for a plan and estimate for a beacon on New South shoal are predicated on so much of the "Act making appropriations for light-houses, light-boats, buoys," &c., approved March 3, 1849, as is contained in the following words, to wit: "For a screw-pile beacon or other practicable structure on South shoal, off Nantucket, lately discovered by the survey of the coast, $25,000, to be expended under the direction of the Bureau of Topographical Engineers." A plan and estimate for a beacon are accordingly herewith submitted. Considering, however, that a beacon would mark the shoal during the day only, and that the risks and dangers of navigation are more imminent and numerous at night, and especially during the boisterous season, when the nights are longest, it has been deemed advisable, in anticipation of the approval of the bureau, to prepare also a plan and estimate for a light-house for the same point. In doing this, less hesitation has been felt, because, in the erection of any work at a position so exposed as the one under consideration, the only real difficulty consists in establishing the foundation; and because the greater cost of a light-house, although certainly considerably more than for a beacon, bears no sort of reasonable comparison when the superior and continuous usefulness of the light-house is considered. It was also conceived that the plan might be so arranged that, in case the beacon structure should be adopted, and should, when raised, be found competent to resist the shocks of the ocean, the project of a light-house might be finally executed. In contemplation, therefore, of that ultimate object, the dimensions of the proposed beacon, in general and in detail, have been enlarged beyond what might be otherwise considered sufficient; but whatever may be the excess thus caused in the estimate for the beacon, it is confined almost wholly to the foundry cost of the structure. In other respects, unless the size of the work should be greatly reduced, the expenses, excepting those in which time enters, would remain nearly, if not quite, the same.

As the two structures, as already stated, are in part common to each other, a description of the light-house, as the larger of the two, will, with occasional reference to the beacon, be sufficient for both.

The foundation is composed of iron piles, so grouped together as to form an octagonal prism, 50 feet in diameter, and about 42 in height. From this prism as a base, rises a truncated pyramid, composed also of iron piles, which inclining inward 6 on 1, for a further height of 120 feet, full within the diameter of 10 feet, and are received and secured in a great ring-piece, which, in turn, is surmounted by the watch-room and lantern, making the whole height 185 feet. The piles, one at each angle, and one at the centre of the octagonal prism, are of 12 inches; those of the truncated pyramid in three lengths, of 12 inches, tapering to 6 inches. The entire structure, including the prism, for the length of the piles, is braced horizontally in seven planes, and diagonally between every consecutive two of these planes, except where the dwelling
of the light or cage of the beacon, as the case may be, interferes, when these are in part omitted. The dwelling stands 40 feet above the highest tides; is composed of three stories of 9 feet each, and communicates with the watch-room and lantern above by a spiral stairway, in a column of wrought iron, 8 feet in diameter. The two lower stories are 30 feet, and the upper story 20 feet in diameter; the first and third stories, as well as the roof of the dwelling, and the watch-room and lantern, being surrounded by galleries. The watch-room and the lantern are 12 feet in diameter; the former 6 feet 9 inches in height, the latter about 12 feet, with the roof and ventilator, &c., 20 feet in height. The beacon occupies but two of the three lengths of piles forming the pyramidal frustum of the larger structure. The cage, the bottom of which is elevated 60 feet, and the extreme top 108 feet above the level of the highest water, is composed of columns arranged in the form of a cylinder, 24 feet in diameter, and 24 feet in height, surmounted by a canopy, giving it a further height of 24 feet.

These are the outline or main features of the two structures. The details will be better understood from the drawings communicated herewith, than from the most lengthened and minute description. They consist of an elevation and vertical section of each work on a scale of four feet to an inch, ( \( \frac{1}{4} \) ), and sixteen sheets of details on the same, and double the scale; and will show, not only the manner of bracing proposed, but also the character of the cage, the arrangement and finish of the dwelling, and passage thence to the watch-room and lantern of the latter; and also the arrangements for securing the boat for taking in stores; the position of the fog-bell; the keeping of the oil, water, and fuel, &c.; and all other particulars, even to the size of the material employed, &c. Talbotype of the elevations and vertical sections, reduced in scale to about \( \frac{1}{2} \), are also appended to the report.

It is now necessary to explain in what manner it is proposed to establish either work on the shoal. It was stated, when describing the applicability of screw piles and pneumatic piles for founding the proposed structures, that as the latter required no mechanical force to insert them into the bottom, the employment of a fixed staging, from which to apply such force as was required in the use of the former, would be unnecessary; and that although a floating body might, by well-digested measures, in favorable weather, be successfully employed in sinking them singly, it would not be practicable to give the number of piles required to found the work their proper relative positions from so unsteady a footing. The utter hopelessness of constructing a fixed platform, under the circumstances, at so exposed a point as New South shoal, at least by such time in the working season as to render it available for the intended purpose, was also shown. What other course, then, shall be adopted in the emergency? It is, in my opinion, not lightly formed, to carry out and deposit on the shoal, by one bold measure, the entire lower or foundation portion of the structure described as the octagonal prism, and by Dr. Potts's process, so simple in its character and wonderful in its results, to sink it in the sand the required depth. It will not escape attention, that in taking this course, the necessary bracings, down to the very level of the shoal, will be
secured to the work; whereas, in putting down the piles separately, the attaching of them is barely possible under the most favorable circumstances, at so exposed a point.

The foundation or lower portion of the structure, already in part described, is formed of nine piles, occupying the angles and centre of the prismatic figure, bound together by two sets of horizontal braces, one twenty feet from the bottom, the other at the top, and by three sets of diagonal braces between these planes. It is necessary to state here, that the lower part of each pile is received by a cylinder having a conical base or foot, through which, by a separate pipe, provided for the purpose, extending to the top of the framing, it is designed to excavate the sand by the pneumatic process. By this arrangement, the advantages of the two systems—of the screw pile and the pneumatic pile—have been combined; the means, on the one hand, by which the soil may be penetrated to the required depth, and the use, on the other, of a shaft, presenting, with a proper bearing, the least exposure, strength considered, to the action of the sea. For the character of this arrangement, and for all other details, reference is respectfully made to the model of the foundation section, on a scale of $\frac{1}{3}$, which will be deposited in the bureau. The work, as designed, including the cylinders with the conical bases to receive the solid piles, and all necessary appendages, such as air-pump and receivers, and air and sand piles, &c., for sinking it into the bottom, weighs 288 tons. To receive and float this great weight, distributed as it is throughout such large bounds, will require twin-camels, each at least 100 feet in length, 15$\frac{1}{2}$-feet beam, and 10 feet depth of hold, or, say, about 160 tons. These camels, when light, will draw little over 3$\frac{1}{2}$ feet water; and when loaded, about 7 feet. Carrying the foundation as proposed, with the lower set of horizontal braces resting on the rail, the cones or shoes of the cylinders will extend nearly 4$\frac{3}{4}$ feet below the keels. In this same position, 61 tons of the weight will be suspended below, while the balance, or 177 tons, will stand above the rail. It will be time enough, should the present design be approved and ordered to be carried out, to digest all necessary details, to insure a full efficiency to the camels; to determine whether they shall consist, as now proposed, of two similar vessels of the ordinary model, or of two having, when combined, the general outline of a single vessel; the most perfect way of securing them to each other, and to their burden; the best arrangement for towing, mooring, and flooding; and, finally, the proper mode of removing them from under the framing when it rests in position on the shoal. It is even now evident that it is desirable so to modify the lower framing that a larger proportion of the weight may be carried below the body of the camels than the present arrangement provides for. Again, it further appears, as far as experiments with the model may be relied upon, that, to insure the uniform descent of the foundation, it is necessary to have either an air-pump for each pile, or, if one air-pump only is used, to communicate with the soil-receivers by air-pipes of equal lengths. The weight on each pile, when resting on the bottom, is 26 2 tons, which distributed over 19.6 feet, the area of the base of the cones, 5 feet in diameter, gives 1.33 ton for each foot. The entire weight of the light-house structure is 640 tons; of the beacon,
466 tons; giving 71.1 tons on each pile, or 3.6 tons on each superficial foot in the case of the first, and 51.6 tons on each pile, or 2.6 tons on each superficial foot, in the case of the second work. To sink the cylinders 19 feet in the sand, the depth proposed, will require the raising in each case of a column of sand of that height, 5 feet in diameter, or 37.3 cubic feet, or about seven times the contents of the receivers, calculated at 54 cubic feet. As there is, however, a large admixture of water with the sand, raised by pumping, the descent of the cylinders will necessarily call for the filling of the soil-receivers much more frequently.

In recommending the carrying out of the foundation in one body to the shoal, the hazards which belong to the entire proceeding, from the departure of the camels with their burden from the selected harbor to their arrival, and the complete establishment of the work at the site, are, it is believed, in no wise underrated. So far from this being the case, it is not improbable that, by dwelling on the subject, I may have rather magnified them. The towing the camels in a sea-way with their load, a large portion of which is, on the one hand, high above their decks, and on the other, far below their water-line; the placing, and then securely mooring them at the selected site; the flooding the camels, and then relieving the foundation, on resting on the bottom, from them, without injury from the heave of the sea to either, particularly the former; and, lastly, the sinking of the piles by the pneumatic process, are all operations, under the circumstances, of much delicacy, liable to great risks, and, as a consequence, involving the issues in much uncertainty. The velocity and ever-changing direction of the currents at the site, and through the group generally; the exposure, and the distance of the shoal from the land; and, above all, if it be possible to draw a distinction where each controlling condition holds so important a place, the distance of the point of destination from a harbor, all go to show that the difficulties and dangers of the operation are of no ordinary character. As its success depends on the vicissitudes of the weather, that is the true turning point in carrying out the final design. But in making these observations, I desire also to say, that, in my opinion, the question is not, as in most cases, a mere selection from several plans, but is reduced to the alternative of adopting the plan now suggested as the only one that has a chance of success, or the entire abandonment of the design, to mark the position of the dangerous shoal in question.

The plan of operations for the erection of the light-house calls for four and a half years, thus distributed: one year and a half in constructing and setting up and taking down the work at the foundry, and transporting it to the selected harbor of refuge and departure; the first season at the shoal in establishing the foundation section at the site; the second season in raising and bracing the pile-framing, and forming the iron-work of the dwelling, &c.; and the third and last season in finishing the interior of the dwelling, &c., completing the lantern, and setting up lighting apparatus, constructing hoisting-davits, &c., putting up fog-bell and striking machinery, water and oil tanks, &c., furnishing, painting, &c., and lighting. The plan of operations for the erection of the beacon covers three years, employed as follows: one year at the foundry in forming structures, &c.; the first season at the shoal in
fixing the foundation section; and the second and last in building up and bracing the framing and forming the cage, &c.

Conceiving, as already remarked, that the placing of the foundation constitutes the main obstacle to a successful issue to the proposed project, a description of the operations to carry it out will be confined to an outline of what would probably be the course in regard to that measure. It is necessary previously, however, to state, that although there is as little as eight feet at low water on the shoal, and an area of considerable extent within the two-fathom curve at the same stage of the tide, it has been thought advisable to design the work for a point in a depth of fourteen feet on the land side, and midway of the length of its crest, which, standing in the relation somewhat of a breakwater, will afford a partial protection to the work against the deep-sea wave. It should also be stated that as Nantucket, the nearest harbor to the shoal, has but six and a half feet at low water at the entrance, Edgartown, the next nearest, with fifteen feet at the same stage of the tide, is selected as the harbor of departure and refuge in the proposed undertaking.

The precise site of the work on the shoal having been marked out by disk buoys, having mooring anchors laid down, &c., and the double section composing the foundation put together on the camels, a favorable state of the weather, with the wind offshore, should be taken to set out from the harbor—so timing the departure as to reach the shoal, distant, as already stated, forty-two miles, by the dawn of day. The time required to make the trip will depend, of course, on the speed at which the steam-tugs can tow the camels with their burden. This will probably be found to be somewhere between three and a half and seven miles per hour; but this point should be settled previously, by one or more experimental trips off the mouth of the harbor. These trials may also be found necessary to ascertain how the camels carry in a sea-way, so as properly to adjust the burden on them, &c. As the draught of the foundation structure, as carried on the camels, is less by two and a half feet than the depth at low water at the point at which it is proposed to found the work, the arrival at the shoal need not be governed by the stage of the tide, though high water is preferable, as, all other conditions being the same, the swell of the sea, in consequence of the greater depth, is then least. Having arrived at the shoal, the operation of depositing the foundation at the site is one which, in case the weather continues propitious, should require but little time to accomplish. As the plan of the work is based on a regular figure, and may consequently take any position relatively with the shoal, the steam-tugs should tow the camels into place on the direction of the current as it then runs, when the anchors will be let go, and the other appliances prepared for the purpose put in requisition, to moor them as immovable as the circumstances of the case will admit. The next proceeding in course is to flood the camels, and bring the foundation on the bottom, when the former may be drawn by the steam-tugs from beneath the latter. A full and well-instructed force, already occupying the work, will then commence sinking the structure by the application of the steam air-pump, by excavating the sand under the piles through the cones
forming their feet, and continue vigorously to prosecute the operation until it descends to the required depth. Twenty-four hours of favorable weather would, it is confidently believed, suffice for the complete and satisfactory accomplishment of this most novel proceeding; and even half that time to place the work in safety on the shoal against any ordinary contingency of weather, in case the state of it at the time should prevent the sinking of the cylinders. The great breadth of the structure compared with its height, and the absolute regularity of its figure, combined with its enormous weight, and the smallness of the surface exposed to the blow of the sea, all go to warrant a confidence in this belief.

Estimates for the light-house, as well as the beacon, accompany the report. They consist in each case of a synoptical estimate under distinct heads, with references to corresponding subordinate estimates, running much into detail.

It has been earnestly desired, by tracing closely the probable course of the operations, to arrive at the true cost of carrying out the designs submitted. No exigency that seemed likely to arise has failed to be noticed and provided for; and hence the opinion is confidently entertained, that either work, if at all practicable, may be executed for the sum set down for it. It may excite surprise that this assurance should be given, when the aggregate in either case is so large. But when the position and character of the locality, and the extraordinary circumstances under which the operations must be carried on, are fully understood and fairly weighed, this feeling, it is believed, will give place to a fixed conviction, that though made up from data as full as the nature of the case would permit, they in no wise exaggerate the probable cost. That the large expenditure called for to consummate the more complete design of the two would be justified by so large an expenditure as that named, the valuable interests that would be subserved by it, as set forth in part in the present report, it is presumed, will generally be admitted.

Of the three great light-houses, Eddystone, Bell Rock, and Skerryvore, the last only was built after the introduction of steam navigation. Mr. Alan Stevenson, the engineer, in his account of the construction of the Skerryvore, says: "From the extent of the foul ground round Skerryvore, and the absence of good harbors in the neighborhood, it was foreseen at the outset that the operations of landing 6,000 tons of materials on the rock could not be accomplished by means of sailing vessels, with that degree of certainty and regularity which was desirable, in order to obtain the full benefit of the short working season which the climate of the western Hebrides affords, and the necessity for providing a steam-tender was therefore generally admitted." Again: "The use of a steamer at the very outset of the works would doubtless have proved of the greatest service in the erection of the barrack on the rock, and would have materially lightened our cares and toils; but I am not sure that I should have acquired so thorough an acquaintance with the difficulties and dangers of the Skerryvore, or that I should have been so well prepared for all the obstacles that presented themselves in the after parts of the work, had the first season's operations been conducted under those advantages which are always derived from the use of steam-power.

54 L H P
As it was, we had much to bear from the smallness of the light-house tender, named the Phanasa—a vessel of 86 tons, new register—which was all the regular shipping attendance we possessed during this first season; and the inconvenience arising from her heavy pitching was, to landsmen, by no means the least evil to be endured. But the frequent loss of opportunities, of which we might easily have availed ourselves if we had possessed the command of steam-power, and the danger and difficulty of managing a sailing vessel in the foul ground near the rock, and between it and Tyree, were, perhaps, even more felt by the seamen than by the landsmen; and if the experience of a single year's work can form any ground for an estimate of the length of time required for building the Skerryvore light-house with a sailing vessel, I should say we must still (even in 1845) have been engaged in the masonry part of the work, which was finished on the 25th July, 1842.” The steamer employed at Skerryvore was of 150 tons, with two engines of 30-horse power each, and cost completely fitted (£5,930) £29,650. An alteration in the engines, by raising the shafts, &c., increased this (£423) £2,115. Repairs on the hull and engines during the progress of the work (£1,957) £5,285. Sailing expenses (£6,001) £35,005, or for each of the four years, 1839 to 1842 inclusive, £8,751. This includes, it should be remarked, coals supplied the different departments of the works, and also the smith's forge.

If, according to Mr. Stevenson, the employment of steam was a matter of economy in time, and, as a consequence, in money, in the operations at Skerryvore, with a harbor of refuge comparatively near at hand, and after the first season a barrack on the “rock” for the accommodation of the workmen, it will not be denied that even a greater pecuniary saving would follow from the employment of the same auxiliary in the operations at New South shoal, a point twenty miles from the land and forty-two miles from a harbor, and no footing on which to establish a residence short of the final structure. The principal duty of the steamer at Skerryvore was to tow the vessels carrying the 6,000 tons of stone forming the structure. At New South shoal the call for transportation, even for the larger work, would be but 640 tons of iron, including the 238 tons proposed to be carried out in one body in the foundation. But, on the other hand, it is necessary to provide a residence for the workmen at the shoal, a position at which can be held not only longer, but be more promptly reoccupied after a storm—the very time, too, when the weather is generally most favorable—by means of steam. A receiving steamer is accordingly provided for; and that she may not be obliged to leave her station, except from stress of weather, a steamer of the smallest class considered safe, to ply as a tender between the shoal and the shore, to carry materials, provisions, water, &c., is also added. These steamers should be propellers, which, besides being less costly to build and to run, are more roomy and have flush decks and sides, and hence better adapted to meet the exigencies of the required service.

Although the range for an elevation of 137 feet, (the least height by the design of the focal plane above the level of the sea,) and the deck of an ordinary size vessel, is quite within the powers of the second order of lenticular lights, it is deemed advisable, in view of the importance
of apprising navigators of the position of the shoal at the earliest moment, to provide in the estimate for one of the first order, which, by the increased volume of light, may not only be seen under a less favorable condition of the atmosphere, but also be distinguished aloft from ships of the largest class when actually below the horizon. The difference in the first cost of the two orders is about $3,000, the difference in the maintenance about $350 annually—confined in the present instance, from the character and isolated position of the light, requiring no larger force, to the greater consumption of oil—say 250 gallons—and the slightly increased cost of the smaller accessories.

I have been assisted in the preparation of the designs of the two works by Mr. William Dennison, of Boston. Besides very many of the details, the arrangements by which the piles are received in the great ring-piece which encircles the stairway cylinder,从而使 the element of reciprocal tension braces, and the tapping of the cones at the base of the cylinder piles, through which and a separate pipe the soil is raised, thus admitting of introduction of the solid piles into them before being inserted into the bottom, are both due to his intelligence. The drawings were also made by him. It will not be expected that the details shall not, to some extent, require modification These it will be time enough to consider and make, on the preparation of the necessary working-drawings, in case it be determined to carry out either. The propriety for some changes is even now apparent: among these, for instance, the reduction of the weight of the great ring-piece just mentioned, as far as may be compatible with proper strength, and the removal of the soil-receivers and their pipes within the area of the base. Neither is it at all improbable that further investigation and reflection may induce a change or reduction to some extent, or both, of the diagonal bracings, which, by their number and near approach to each other, may cause the ice to form, particularly in the series just above the level of the sea, in such masses as to endanger the safety of the structure. At present these bracings are of three kinds: one set in the faces of the octagonal prism or truncated pyramid, as the case may be called in the estimate panel; another set in planes, whose horizontal projections are as radii of those figures, called radial; and a third set, forming an endless rod, taking hold in succession of every third pile and alternating between two consecutive series of spider-web bracings, called chord—these last serving both as tension and torsion bracings.

Besides the plan already noticed, I beg to call attention also to a small tripod beacon (of which an elevation and perspective are forwarded) designed to be thrown entire on a shoal. The feet are formed of inverted cones, having disks increasing in size upwards, and so inclined as to be parallel with the horizon, which there is good reason to believe would, under the action of the currents and the waves on the sand, sink not only uniformly, but sufficiently deep into the bottom to give the work, from the small exposure of the superstructure to the same action, the necessary stability. As it is with a view merely to call attention to a measure that may possibly lead to future useful results, and as the present plan is not free from serious objection in the details, no estimate either of the weight or cost has been prepared.
The entire height of the beacon above the water is about 70 feet; the size of the cage 17½ feet by 8½ feet.

While on the subject of establishing sea-marks by so summary a process, I trust I may be excused for suggesting the trial of disk buoys to mark to some slight degree of usefulness the principal shoals off Nantucket. These buoys have been used by me in hydrographical surveys now for some years, with the most satisfactory results—among the last occasions at the Tortugas, where, though of but 100 pounds in weight and 21½ inches in diameter, and with a wooden staff, they stood immovably on the outer side of the reefs, exposed to the roll of the sea from the Gulf. Buoys for the experiment should, with the same general form, have greater weight—say 250 to 500 pounds, with a tapering iron staff, or one of round iron of diminishing sizes, properly coupled, and surmounted by a flag attached to a light iron vane-like frame. The first cost of a buoy such as described, of 250 pounds, would not exceed $25; of 500 pounds, about $35. A tracing of a buoy of this kind, with a disk of 500 pounds, is forwarded herewith.

In addition to the drawings and papers already mentioned, a Coast Survey sketch of the Nantucket group, scale 200000; a Coast Survey MS. tracing of New and Old South shoals, scale 400000; Coast Survey charts of Nantucket, Edgartown, and Holmes's Hole, and a chart (Blunt's) of the coast from Absecon Inlet to the Penobscot, showing the general contour of the coast and the relative position of these harbors with New South shoal, are also forwarded, as necessary to a proper understanding of the report.

I beg to make my acknowledgments to Professor A. D. Bache, Superintendent of the United States Coast Survey, for copies of charts of Nantucket, Edgartown, and Holmes's Hole, and of a sketch in part (MS.) of Nantucket shoals, and for information in reference to them, used in the preparation of the present report. I am likewise indebted to him for facilities, through the steamer Bibb, engaged in laying down the group, to examine New South shoal; and also to Lieutenant Commanding C. H. McBlair, of that vessel, and his officers, for their attention in furthering the object of my visit; and likewise to Lieutenant Commanding McBlair, for a copy of the weather journal of the Bibb for 1847, 1848, and 1849. It is proper I should also express my acknowledgments to the several collectors of the customs of the ports named in the statements herewith, for their prompt response to the call made on them for the commercial statistics they embody.

The delay in the presentation of this report was occasioned, in the first instance, by other and more pressing duties; and since then by the time required to prepare the model, drawings, including the estimates, and to obtain the necessary commercial information which accompanies it.

I have the honor to be, sir, very respectfully, your obedient servant,

HARTMAN BACHE,


Colonel J. J. Abert,

Bureau Topographical Engineers.
Statement of the exposure, distance from land and nearest harbor, nature and height or depression of the bottom, rise and fall of the tide, and velocity of the current, at Eddystone, Bell Rock, Skerryvore, and New South Shoal: also the cost and length of time required to erect the light-houses at the three points first named, and the estimated cost and probable length of time required to erect the proposed light-house at New South Shoal.

<table>
<thead>
<tr>
<th>Position</th>
<th>Exposure</th>
<th>Towards the sea</th>
<th>Towards the land</th>
<th>Distance from land</th>
<th>Distance from nearest harbor</th>
<th>Nature of the bottom</th>
<th>Height or depression of bottom, compared with low water</th>
<th>Rise and fall of the tides</th>
<th>Velocity of the current</th>
<th>Cost</th>
<th>Length of time erecting</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eddystone</td>
<td>166</td>
<td>English channel and Atlantic ocean.</td>
<td>Deg. 194</td>
<td>Miles 9 1/2 to 44</td>
<td>Miles 13 1/2 Rock</td>
<td>Feet 12 Not known</td>
<td>Feet 18 Not known</td>
<td>Not known</td>
<td>$180,000</td>
<td>4</td>
<td>1756 to 1759, inclusive. The mean height of the rock above low water is given. Light first exhibited October 16, 1759.</td>
<td></td>
</tr>
<tr>
<td>Bell rock</td>
<td>140</td>
<td>North sea, or German ocean.</td>
<td>Deg. 220</td>
<td>Miles 13 1/2 to 77</td>
<td>Miles 15 Rock</td>
<td>4 Not known</td>
<td>16 Not known</td>
<td>Not known</td>
<td>$306,657</td>
<td>4</td>
<td>1807 to 1810, inclusive. Light first exhibited February 1, 1811.</td>
<td></td>
</tr>
<tr>
<td>Skerryvore</td>
<td>133</td>
<td>Atlantic ocean.</td>
<td>Deg. 227</td>
<td>Miles 10 1/2 to 103</td>
<td>Miles 10 1/2 Rock</td>
<td>17</td>
<td>12 1/2</td>
<td>2 1/2 to 4 1/2</td>
<td>$449,096</td>
<td>6</td>
<td>1838 to 1843, inclusive. Light first exhibited February 1, 1844; surveys 1834 and 1835; opening quarries, &amp;c., 1836 and 1837. The nearest harbor is Hynish bay, which being open through a large arc, others about the islands of Coll and Mull, in some instances 40 miles distant, were used; 2,000 tons of stone were cut off the rock before building.</td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td>Exposure</td>
<td>Towards the sea.</td>
<td>Towards the land.</td>
<td>Distance from land.</td>
<td>Distance from nearest harbor.</td>
<td>Nature of the bottom.</td>
<td>Height or depression of bottom, compared with low water.</td>
<td>Rise and fall of the tides.</td>
<td>Velocity of the current.</td>
<td>Cost.</td>
<td>Length of time erected.</td>
<td>Remarks</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>------------------</td>
<td>-------------------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>New South Shoal</td>
<td></td>
<td>Deg. 270</td>
<td>Atlantic ocean.</td>
<td>Arc. 90</td>
<td>Miles 20 to 103</td>
<td>Miles 42</td>
<td>Hardsand.</td>
<td>Feet 8</td>
<td>Feet 4</td>
<td>Miles 1 1/2 to 2 1/4</td>
<td>§322,787</td>
<td>Yes, §3. One year and a half in addition in the preparation of the structure. Nantucket is 40 miles distant; but this harbor would not always be available, from the limited depth at the entrance (six and a half feet) at low water.</td>
</tr>
</tbody>
</table>

* £37,800.          † £61,331 9s. 2d.        ‡ £89,817 6s. 11d.  

Office of New South Shoal Beacon,  
*Philadelphia, December 27, 1851.*

HARTMAN BACHE,  
Major Topographical Engineers, Brevet Major.
TREASURY DEPARTMENT, March 9, 1852.

SIR: I have the honor to transmit herewith, at the request of the Fifth Auditor of the Treasury, a communication from that officer respecting the light-house system of the United States.

I am, very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Hon. Linn Boyd,
Speaker of the House of Representatives.

TREASURY DEPARTMENT,
Fifth Auditor's Office, March 8, 1852.

SIR: I have the honor to enclose a reply to the report of the Light-house Board, which I request you to lay before the House of Representatatives as early as your convenience will permit.

In this reply I have shown, 1st, That the lights on our coast are satisfactory to our captains of ships and pilots generally.

2. That the annual expenses of them are very little more than one-third of those of Great Britain, either as it respects light-houses or light-ships.

3. That our light-ships are superior in all respects to the British.

4. That the oil for the light-houses is inspected in the best manner, by requiring it to stand a degree of cold of thirty-two degrees of the thermometer for winter pressed oil, and forty-five for spring pressed oil, and by burning some of each cask at the custom-house.

5. That the French lenses are more expensive, without showing a better light, than the reflectors, as is proved by the Trinity Board in London.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

Hon. Thomas Corwin,
Secretary of the Treasury.

TREASURY DEPARTMENT,
Fifth Auditor's Office, March 8, 1852.

SIR: The report of the Light-house Board, appointed under an act of Congress of the last session, which has been recently laid before Congress by the Secretary of the Treasury, is so full of errors in relation to our Light-house Establishment, upon which it recommends a transfer from this office to a board to be composed of naval and military officers, as to demand from me a reply.

When it is recollected that so long ago as 1837, a long list of charges were made by a firm in New York against my management of the Light-house Establishment, one object of which was to establish a board of Navy officers to take the management out of my hands, and that these charges were in every essential particular refuted by my answer, which, with the
charges, were laid before Congress and printed. (Senate document No. 188, 2d session 25th Congress.)

That, at the commencement of General Harrison’s administration, a systematic attack was made on the Light-house Establishment by persons who had no interest in the lights whatever, and who prepared a speech to be delivered, and was delivered by a member of the House of Representatives from the West, who had probably never seen a light-house. By this speech, persons not acquainted with the subject would be led to suppose that the lights were utterly worthless, and that many of the buildings had fallen down, and all were so badly built as to be liable to fall. My answer, which was communicated to the Committee on Commerce, and published with their report, (2d session 27th Congress, House document No. 811.) put these accusations to rest.

That at the same session, resolutions were introduced into the House of Representatives for the Committee on Commerce to inquire into all the alleged causes of complaint, and also whether the Light-house Establishment ought not to be transferred from this office to that of the topographical engineers. The report, referred to above, was a triumphant vindication of my management of the establishment, and also contrasted our lights favorably with those of England and France, and showed the superior economy used in our establishment.

That about this time the then Secretary of the Treasury employed one of these complainants to examine and report the condition of the several lights on the coast of Maine. As might have been expected, this man drew up false certificates as to the condition of the lights, which he induced the keepers to sign without reading, or having them read. Seeing that these certificates did not agree with the reports of the superintendents made just before, I sent copies of them to the superintendents, to be submitted to the keepers, and without exception they pronounced them false, and that they signed them without a knowledge of their contents. The report of this person was communicated to the House of Representatives on the 24th of February, 1845, and is No. 183. To rebut and refute other parts of his report, I instructed the several superintendents from Maine to Louisiana, to obtain the opinion of captains of ships and pilots as to the quality of the lights on the Atlantic coast, and send them to me. These were laid before Congress by the Secretary of the Treasury on the 18th of January, 1844, (the first session 28th Congress, House document No. 62.) By this it will be seen how utterly groundless were all the complaints of this man.

That, after this period, this person was supplied by Mr. Lepante, the manufacturer of the lenses in France, with two or three of the four orders, upon which he lectured in all our principal towns, from Boston to this city, with the view to influence their adoption in this country, by which Mr. Lepante, and probably himself, would have made large fortunes. In his lectures he misrepresented their advantages, which I caused to be corrected at the time, in some of the public gazettes.

That, after this period, viz: in 1845, the then Secretary of the Treasury sent two young officers of the Navy, Lieutenant Richard Bache and Lieutenant Thornton A. Jenkins, to Europe, to obtain information concerning the light-house establishments in such of those countries as pos-
sessed them. Their report was communicated to the Senate by the Secretary in August, 1846, and will be found in Senate Doc. No. 488, of the 1st session, 29th Congress. In this report these gentleman denounced our lights as inferior to all they had seen in Europe, found fault with everything done in the light-house department of this country, recommended strongly the adoption of the French lenses, and also a board of officers to devise some other plan for managing our light-house establishment. To this report I replied in a communication to the Committee on Commerce of the Senate, the chairman of which was the honorable John A. Dix, to whom the report had been referred, and as that reply has never been printed, a copy is hereto annexed. The committee, on receiving my explanation, which referred to and refuted every ground of complaint in the report of any importance, determined to take no action upon it, and none, as far as I can learn, has ever been taken on it since.

When, I repeat, it is recollected that all these charges have, from time to time, been made against the light-house system and its management in my hands, and that they have so often been successfully repelled, it is a matter of astonishment that they should now be repeated, with a few unimportant additions, in a report lately made to Congress by men of the high standing and talents of those composing the light-house board, at a time, too, when the lights on the coast are reported to me to be better than they ever were, in consequence of my having recently substituted for the old lanterns containing small panes of inferior glass, those containing large panes of French plate glass, and the improved reflectors made in moulds or dies.

The report finds fault with everything, and approves of nothing, which has been done by the light-house department. Now, when it is considered that in 1844 it was shown to Congress, (House Doc. No. 62, 1st session, 28th Congress,) and the country, that nine-tenths of the captains of ships sailing out of the different ports of the United States, coastwise and to and from Europe, from Maine to Louisiana, as well as the pilots of each port, expressed their entire satisfaction with the lights on the coast; and, subsequently to this period, the superintendents of lights reported many of them to have been improved, as before stated, I would respectfully ask whether this be not of itself a sufficient refutation of the charges contained in the report. But this is not all. The marine societies at Boston and Portland, Maine, composed of merchants, underwriters, and masters of ships, have sent me votes of thanks for the security afforded to their vessels, and the persons on board of them, by the excellent quality of lights upon the coast. The merchants of Baltimore also, to testify their sense of the good condition of the lights in Chesapeake bay, and on the Atlantic coast, presented to me a few years ago, what I cherish most highly, a gold medal. Copies of the letters which passed on all these occasions are herewith enclosed.

Having shown on several former occasions that our light-houses and light vessels were maintained annually at about one-third the expense of the British lights of the same kind, upon an average, and for a somewhat less sum than the French light-houses cost for their maintenance, I refrain from repeating the comparison here; remarking only that,
according to the expenses of the English lights laid before Parliament, the same difference continues to exist. That Congress may have a view of the expenses of the British lights, I send herewith the account of expenses laid before Parliament in 1848, the last return of the kind in my possession.

The Light-house Board complains that the light-house towers are badly built, and built without science. That some of the inferior towers are badly built is admitted, and if the board will inform me how it is to be prevented at all times, I shall be much obliged to it for the information. On all occasions of building lights, I have directed the proper collector to appoint a respectable mechanic to oversee the materials and work, day by day, as the contractor progressed with the work, and to make no payment until the work was done to the satisfaction of the overseer. These overseers have sometimes been faithless, and given certificates as to the goodness of the work, when it ought to have been condemned; and this was not discovered until after the contractor was paid, and we had no remedy. The same thing would probably happen if engineers, at ten dollars a day, were employed as overseers, for few, or none of them, would attend the building of houses on a desolate coast, remote from inhabitants. In building all the more important lights I have employed engineers, with as much science, united to practice, as any to be found in the country.

The board also complains that our floating lights are very defective, and much inferior to the British. In this it is altogether mistaken. They have been planned by the first ship-builders in this country, and are as much superior to the British floating lights as our ships are admitted to be superior to British. Henry Eckford, and Webb and Allen, of New York, Mr. Brodie, of Norfolk, afterwards naval architect, and Captain Esby, of this city, were all concerned in planning them. The hulls are not only better calculated for riding at anchor than the British, but the lanterns run up and down between two masts, and are kept at the mast-head by weights, whilst the British lanterns are made to go round the mast, and of course much of the light is concealed. It is alleged by the board, too, that we ought to adopt the British mode of using reflectors, when it will occur to any person who will sufficiently reflect upon the subject, that the rolling of the vessel in a heavy sea would cause these reflectors to throw the light up and down, and it would only be for the moment, when it would be perpendicular, that the light would be seen at all. I have been in possession of one of those reflectors for some years, and would not adopt them for the reason assigned. They have two motions, but neither of them would be quick enough to keep the reflector perpendicular. Our lamps are hung with the quick motion of the compass, and always keep their equilibrium. I have English and American drawings of floating lights, which I should be happy to exhibit to any person who may feel an interest in the subject, and I feel very confident that they would prefer the American model.

The board complains, also, that there are too many lights on the eastern coast, and too few on the southern. I should be glad to know how I could prevent or remedy the evil. Congress very generally makes
appropriations for lights without consulting me; and all I can do, under a clause which has been inserted in each light-house law for some years past, was to request the Secretary of the Navy to detail officers of rank to examine all doubtful sites, and report their opinions as to the expediency or otherwise of erecting the buildings. Formerly many sites were condemned by them, but for some years past, they have, in several instances, recommended the establishment of lights where they have been since found to be useless or unnecessary. An instance of this occurs in the light-house erected at Parmet river, in the cove of Cape Cod, a few years ago. A commander in the Navy, of high standing, was detailed to examine the site, which he did, and recommended the establishment of the light. After it was built, it was examined by the collector of Boston and several other respectable persons, and pronounced to be useless; the river, which was supposed to be a harbor for vessels in bad weather, was found to be only two feet deep. As I had no authority to discontinue the light, I directed that one lamp only should be lit up. When the light-house at Sand Key, near Key West, shall be built and lighted, a light of the first importance on the coast, and the one at Sea Horse key, near the entrance of the Suwannee river, shall be built, for which I have called for an additional appropriation. the coast of Florida, the most dangerous in our country, will be lighted, though Captain Coste, of the revenue service, recommends two others, between Key West and Cape Florida, whose letter upon the subject, I have transmitted to the Committee on Commerce of the House of Representatives.

In the report of the board great stress is laid upon the importance of adopting the French lenses in our light-houses, as was also urged in that of Messrs. Bache and Jenkins, before referred to. In my reply to their report, which is equally applicable to this, I took occasion to compare the cost of our reflector lights with the cost of the lens lights of equal grade. The consumption of oil and the number of keepers in each order of lenses, (there being four,) were derived from Mr. Fresnel's report to me, and laid before Congress, (2d session, 27th Congress, House Doc. Noc. No. 274,) so that the expenses of the lenses are derived from authority that cannot be disputed. It will be seen that the expenses of the lenses are considerably more in every order of lens, and as the light is reported by the Trinity Board to be no better than that from reflectors, I have been opposed to the introduction of any of them, except the flashing light of the second order, which is useful as a distinguishing light. To show the distance these lights can be seen, I send herewith a list obtained from Mr. Fresnel, of all their lights, most of them being fitted up with the different order of lenses, by which it will be seen that our best reflector lights can be seen as far as the best lens lights, and that we have very few light-houses which cannot be seen further than the small order of lenses.

Since the above was written, I have received from Captain Green Walden, of the revenue service, a letter stating "that during our winter cruise, we have had a favorable opportunity of witnessing the brilliancy of all the lights in the night time, along the coast of Maine and Massachusetts, and, in justice to the keepers, I have the pleasure to
inform you that they are in excellent order, and that lights have been seen at a greater distance than for many years. General satisfaction has been expressed by all with whom I have conversed on the subject.”

Also, a letter from the collector at Edgartown, transmitting the opinions of twenty-four captains of ships and pilots, as follows:

“The undersigned captains and pilots of vessels, passing over Nantucket shoals and through the Vineyard sound, hereby certify, that in our opinion the lights in this region are good lights, and entirely satisfactory to those who navigate these waters.” Also, a letter from Captain Richard Evans, of the revenue-cutter Campbell, at Norfolk, in which he says: “The lights in this district always show well. I presume to say that these lights can be seen from the deck of this vessel, in clear weather, from ten to fifteen miles. The lights, so far as my observation has gone, are generally well kept.” These several papers are annexed, marked No. 5. To these I have added the favorable opinions of captains of vessels and pilots of Portland, Maine; Boston; New York; Wilmington, Delaware; and Baltimore, Maryland; which were received in the fall of 1847, and which have not yet been published. The captains and pilots express themselves as follows:

“We, the undersigned, commanding vessels sailing to and from the port of New York, avail ourselves of this opportunity of expressing our entire satisfaction in regard to the efficiency of the lights on the coast, on the sound, and on the Hudson river.” All these papers are hereto annexed, and numbered seven. They comprise the names of about four hundred captains and pilots, most of whom are acquainted with the lights from Maine to Louisiana.

From the collector at Newport, Rhode Island, I have just received a letter, from which is the following extract:

“In regard to other parts of the country I am not qualified to speak, but from this district to New York, through Long Island sound, I should certainly think it safe to pronounce the lights good, without fear of contradiction; there are no doubt degrees of excellence, as in everything else; an incident bearing upon the question at issue, occurred here within a few days. The schooner Lucy Blake, of Rockland, New York, arrived here after a very bad night in the sound. He, the captain, remarked, ‘what capital lights you have; without them I should have been lost last night.’ These, with other remarks of the kind, were voluntary, and may be fairly taken as one item of public opinion. Similar observations on the subject are extremely common.”

I have heretofore stated the difference of expense in favor of the United States in maintaining their light-houses and floating lights, compared with those of England, Scotland, and Ireland. I now insert a comparison of the expense of the English and American lights for the year 1846, the latest I have received from England, as follows:

**British Lights.**

Cost of maintaining 66 light-houses one year, (1846,) per statement No. 8, herewith, £35,685 17s. 11d. sterling—equal to $178,420—average per light............. $2,703 48

Cost of 26 light-boats, same period, £33,999 sterling—equal to $169,999—average per light............. ..... 6,538 45
### United States Lights

Cost of maintaining 259 light-houses one year, (1846,) as per statement No. 9, $284,472—average per light.  

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of maintaining 259 light-houses</td>
<td>$1,098</td>
</tr>
<tr>
<td>as per statement No. 9, $284,472—average per light.</td>
<td></td>
</tr>
<tr>
<td>Cost of maintaining 30 light-boats, same period, as per said statement No. 9, $86,669—average</td>
<td>$2,888</td>
</tr>
<tr>
<td>259 British lights would, at the above average, cost per annum</td>
<td>$700,200</td>
</tr>
<tr>
<td>259 United States lights cost</td>
<td>$284,472</td>
</tr>
<tr>
<td>In favor of the United States</td>
<td>$415,728</td>
</tr>
<tr>
<td>30 British floating lights would cost, at the above average</td>
<td>$196,153</td>
</tr>
<tr>
<td>30 United States floating lights cost</td>
<td>$86,669</td>
</tr>
<tr>
<td>In favor of the United States</td>
<td>$109,483</td>
</tr>
</tbody>
</table>

The board also complains that there is no attention paid to the testing the oil before it is received and sent to the light-houses. In this it is also in error. In a letter from Mr. Congdon, the person appointed to inspect the oil at Boston, in answer to a complaint from the lakes, he states, “the oil sent from Boston to the lakes was furnished by E. Milliken & Co., and was the first lot which I examined the present year. I tried the burning of each barrel, and the oil was entirely consumed in each lamp, with the exception of three or four, out of nearly 100 used, and in these three or four but very little remained. This was the case with both winter and spring oil. For the winter oil I adopted the test of the late Mr. Harris, formerly the inspector for the Government, that is, 32 of the thermometer. I tried the oil in a mixture of ice, salt, and water, and not a cask was sent that did not remain limpid at 32, and the greater part at 30. I also tried it on ice, and it remained limpid for the space of fifteen minutes. The spring oil I tested at a temperature of 45 degrees. I had previously ascertained that oil strained in the month of April would remain limpid at this temperature.”

Having shown that our lights are satisfactory to almost every person interested in commerce and navigation, and that they are maintained cheaper than any others in any part of the world, I would respectfully inquire whence it is that these repeated attacks are made upon the establishment, by persons who have no interest in commerce whatever, with propositions to change its management—at one time to an entire navy board; at another to the topographical bureau; and lastly, to a board to be composed of navy and military officers, as if they had not enough to do in the line of their respective professions.

Whenever Congress may consider it expedient to change the superintendence of the light-house establishment, which I have built up from the inconsiderable number of 54 to the number of 330 light-houses and 41 light-ships, with numerous buoys, beacons, &c., within the 32 years I have had charge of it, I feel warranted in saying that a board, however composed, would not be the proper authority to which to commit
it; and that a single officer attached to the Treasury Department, who should be responsible for the welfare of the establishment, and the proper application of the moneys appropriated for its support, would insure the best attention to its wants, and the most economical expenditure of the public moneys.

I have the honor to be, very respectfully, sir, your obedient servant,

S. PLEASONTON.

The Hon. Thomas Corwin,
Secretary of the Treasury.

Treasury Department,
Fifth Auditor’s Office, January, 1847.

Sir: The Secretary of the Treasury having thought proper, in June, 1845, to despatch two navy officers, Lieutenants Richard Bache and Thornton A. Jenkins, to Europe, to obtain information upon the subject of light-houses, did, on the 5th of August last, communicate their report to the Senate of the United States. Of this report I have only lately obtained a copy. Had these gentlemen confined their report to such information as they had received abroad, although every essential part of it was in my possession, and much of it had been communicated by me to Congress heretofore, I should have taken no notice of it; but as they have made a broad declaration “that our lights are far inferior to any and all we saw during our visit to Europe,” I consider it due to myself as well as to our Light-house Establishment, which I have had in charge for the last twenty-six years, to show that such an allegation is totally unfounded, by proof that no candid man can disregard. Similar charges have been made from time to time since 1837, by men who had no interest in commerce or navigation, and in so imposing a manner in 1842, that the House of Representatives were induced to direct the Committee on Commerce to inquire into the whole subject, and also “whether the Light-house Establishment ought not to be placed under the charge of the topographical bureau,” and this seemed to be the chief object of the complainants. The report of the Committee on Commerce, of the 2d session 27th Congress, No. 811, is before the country, in which they not only contrast our lights, and the expenses attending them, favorably with those of Europe, but are decidedly averse to transferring the Light-house Establishment to the topographical bureau. In this report, it is seen that our best lights are seen as far as those of France or England, and that the number of our small lights bears no proportion to those in either of those countries. It is also seen by this report, that the maintenance of our lights annually costs about one-third of those of England, including repairs, and less than those of France, exclusive of their repairs; and that out of appropriations for building about 200 light-houses and light-vessels, amounting, in the former, to $1,248,708, the sum of $224,216 was saved and carried to the surplus fund; and in the latter, out of an appropriation of $359,600, $59,121 were, in like manner, carried to the surplus fund.
I might have rested for my justification in managing the Light-house Establishment on this full and able report, both as it regards the efficiency of the lights, and the economy used in building and maintaining them; but, in order to remove all doubt upon the subject, if any existed, as to the excellence of our lights, I directed the several superintendents on the Atlantic coast, from Maine to Louisiana, to open books at their respective custom-houses, and to invite all captains of ships and other vessels, when they called to enter their vessels, to enter in those books their several opinions as to the character of the lights on our coast. This was done, and a report of the same was laid before the House of Representatives in January, 1844, first session of the 28th Congress, document No. 62. It comprised the names of nearly 1,000 captains of ships and other vessels, many of whom were engaged in foreign trade, and well acquainted with the lights in Europe; and of this number, it will be seen that at least nine-tenths bore testimony to the excellence of our lights. I extract a few of their observations, as well as those made by the Marine Society, at Portland, Maine, showing that our lights were as good as those in Europe; that they were sufficiently distinguished from each other; and that it was not desirable that any change should be made in the manner of constructing and lighting them.

---

PORTSMOUTH, NEW HAMPSHIRE,
November 27, 1843.

We, the undersigned, masters of vessels and others at the port of Portsmouth, New Hampshire, hesitate not to say that, in our opinion, the lights on the coast of the United States, as far as our observation extends, are equal to the lights on other coasts, and that they can be seen at as great a distance.

Signed by one hundred and twenty-nine masters of ships and others interested in navigation.

---

Statement of shipmasters and mariners in relation to the lights in New York district.

NEW YORK, May, 1843.

The undersigned, shipmasters and mariners sailing out of the port of New York, or from time to time entering and departing from the port of New York, take pleasure in certifying that at the present time, and for two years past, the lights in the light houses and light-ships on the coast and the approaches to the harbor of New York have exhibited an appearance of steadiness, uniformity, and brilliancy very satisfactory to the interests of navigation, and superior to the experience of former years. We consider the efficiency of the lights and the management of the light-houses in the district of New York for two years past, and the present time, to be worthy of the commendation of the shipping interest.

Signed by three hundred and seventy shipmasters and pilots.
Copy of a letter from John Howard, of New London, in relation to the light-house system of the United States, taken from among many others of similar import.

NEW LONDON, November 17, 1846.

I, John Howard, of New London, in the State of Connecticut, having been employed in the coasting trade forty-eight years, and for the latter thirty years master mariner, sailing from this port to New York, at the desire of the collector of New London, do hereby certify that I have at all seasons of the year, and both day and night, been on the coasts aforesaid; and I do solemnly state that, in my opinion, the present light-house system is every way adapted to the wants of the navigator, and is sufficient for the protection of the mariner. Any alteration in the system would, in my opinion, be hazardous.

JOHN HOWARD.

At an annual meeting of the Portland Marine Society,* held the 19th of December, 1843, the following preamble and resolves were unanimously passed:

Whereas this society, having been requested to give its opinion whether any new light-house is required on the coast of Maine, have had the subject under consideration, and now state that, excepting a small harbor light at Little river, in Cutler, they believe that no further lights are needed on this coast; and the society unanimously

Resolved, That much credit is due to the chief superintendent of the light-house department of the United States for his attention to the wants of the navigating interest, and his successful exertions in the maintenance of good and efficient lights.

Resolved, That the light-houses on the coast of Maine answer fully and effectually all the purposes contemplated in their erection, and that our shores are well and sufficiently lighted.

Here there is an array of testimony against Lieutenants Bache and Jenkins, and from a class of men more interested in the good condition of the light-house establishment than any other, as to the excellent character of our lights.

But this is not all. So late as the summer of 1845, the House of Commons, in England, constituted a committee of fifteen members, at the head of which was Mr. Hume, with a view, among other things, to relieve their shipping from the heavy tonnage duty paid by their lights, and to reduce the expenditures of their light-house establishment. Of this report I am in possession of a copy. The committee called before it a large number of persons supposed to be acquainted with lights, took and reported their testimony, and among them that of Captain Moore, commanding the ship "Hendrick Hudson," trading between New York

* This society is composed of one hundred and sixty members interested in navigation.
and London, and Captain Washington, of the royal navy, engaged in
surveying the English coast; and these gentlemen testified in part as
follows in regard to the American lights:

Captain George Moore called in and examined, May 1. 1845.

Are you a native of America? No; I was born in England, but I
have been more than thirty years in the United States.

What are you? I am a captain in the American service. How long
have you been engaged in the mercantile service between America and
England? About twenty-three years. In regular, continuous service?
Yes; steadily engaged for twenty-three years, with very little exception—
not enough to name.

* * * * * * *

The difference of expense, it will be seen, is in the large number of
keepers necessary for the lens lights, and this is one of the great objec-
tions to the employment of them, for, in France, to the first and second
order of lenses, they employ three keepers to each, and sometimes four,
which would be equally necessary in this country, where they would
cost from four to five times as much as they do in France, the pay of
the principal keepers there being but six hundred francs or one hundred
and twenty dollars, and the assistant four hundred francs or eighty
dollars per annum each. Another objection, still stronger, to the adop-
tion of the lens light, would be the difficulty of obtaining suitable head
keepers, and the frequent change of keepers incidental to our form of
government, and the danger thence arising of loss of light and ship-
wrecks.

It may be observed, in answer to these objections, that the Carcel lamp
now in use may be changed for one more simple and steady, and may
be safely committed to one keeper, who may be had at a cheap rate.
Whatever may be the form of the lamp, there being but one in each lens
to afford all the light, I should consider it dangerous and impolitic to
confide the keeping of that lamp to less than three keepers on the sea-
board, where the largest order of lenses must be used, and two on the
bays and rivers, whilst the reflector lights, containing from ten to thirty
lamps, can be, and are safely confined, in the eastern and middle States,
where it is not sickly, to one keeper; for, if the light in one or two of
those lamps should become extinct, there are a sufficient number left
burning to guide vessels into port.

These objections apply more particularly to the United States. In
France, where suitable keepers are obtained at a cheaper rate, and where
the lenses are made, they are no doubt adopted with advantage, particu-
larly as a great proportion of their lights are harbor lights, and lit up
for a few hours only each night, while the tide is high, in order to ena-
ble vessels to enter the respective harbors, and these are stated by Mr.
Fresnel to be lit up from seven hundred to eleven hundred hours in the
course of a year, out of four thousand hours which he sets down as em-
bracing the year. One keeper attends these lights at a cheap rate, and
consequently their yearly cost is but trifling.

The colza, or rape-seed oil, recommended for use in our light-houses

55 L H P
by Lieutenants Bache and Jenkins, like all vegetable oils, becomes thick and unfit to burn in a short time, and Mr. Fresnel, who uses it in France, is obliged to send it to the light-houses every three or four months, whilst in the United States we send our supply of sperm oil once a year only, at an expense of about eight thousand dollars. Were we to employ the rape-seed oil, and send it four times a year to the light-houses, the additional cost of freight would, of course, be twenty-four thousand dollars, and, as we should have to import this oil, which costs in England 3s. 8d. sterling a gallon, and about the same in France, with freight and other expenses on it, it is very clear that it would not be advisable to use it in our light-houses.

Cotton-seed oil would be equally good, and ought to be preferred as a production of our own country, but it is liable to the same objection; the cost of freight in sending it so often to the light-houses, added to the cost of the oil, would make it more expensive than sperm oil. Upon the whole, I consider the best sperm oil as the most suitable material for affording light in our light-houses, as it is at once steady, safe, and brilliant, at all seasons of moderate price, and will remain good an entire year. It is a production, too, of our own countrymen, and connected with the great nursery of our seamen, upon which the Government must rely for the enforcement and protection of our rights on the ocean, and, to the extent of a supply of oil for our light-houses, ought manifestly to be encouraged.

As many persons believe, and have asserted that the lenticular lights were more luminous, and could be seen further than reflector lights, a committee from the Trinity Board, in visiting the Scotch lights, took occasion, for which there was the best opportunity at the Isle of May, of determining this matter. At that place there were two lights, one with reflectors, and the other with the first order of lenses. The committee had them both lit after sundown, and run off to sea in their vessel for two hours, at the end of which time they found the reflector light was the largest, and the lens light the whitest. I have caused their observations upon the subject to be copied from the report of the House of Commons of 1845, as follows:

Extract of a report of the deputy master and committee of the elder brethren of the Trinity House:

"At two o'clock p.m., on Monday, the 10th October, left the harbor, accompanied by Mr. Stevenson, to inspect the light on the Isle of May, which we reached at half past five, and landed. The temporary light was the same that had been removed from Inchkeith; in the lantern were two circles of reflectors, eleven in each, and in the new light-house a French fixed lens light, with four tiers of looking-glasses below and seven above, with twenty-four in each tier, fitted exactly in the same way as ours at the start; the lantern is rather small, being only eleven feet six inches, but the establishment is of the first order; arranged with Mr. Stevenson to have all the Argand lamps lighted in the direction between S. and SE., and at seven took our leave of Mr. Stevenson; went on board, and steered S. SE., keeping the new light, which was the highest,
open to the west of the low, and continued that course till it could no longer be seen from the deck, which was at forty-five minutes past nine. During the whole time that the lights were visible together, which was till five minutes past nine, when the low light was put out, (we having given directions that it need not be kept lighted more than an hour and a half after we left the island,) they were so exactly alike, that it was almost impossible to discover any difference; if there was any, we thought the light from the reflectors rather the largest, that from the refractor rather the whitest."

I would respectfully inquire whether it would be expedient or politic to rely on a foreign government or country for the means of lighting our extensive coasts, lakes, and rivers, whilst the means afforded and employed by our own country are every way adequate to our wants and satisfactory to all our navigating people, so far as my knowledge extends.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

To the Hon. John A. Dix,
Chairman of the Committee on Commerce of the Senate.

Report of the Secretary of the Treasury in answer to a resolution of the Senate calling for information in relation to contracts for light-houses authorized to be erected by Congress on the Pacific coast.

APRIL 26, 1852.—Referred to the Committee on Commerce, and ordered to be printed.

TREASURY DEPARTMENT, April 24, 1852.

SIR: I acknowledge the receipt of the resolution of the Senate of the 5th instant, requesting information on the subject of contracts for the light-houses authorized by Congress to be erected on the Pacific coast; and, in reply, I have the honor to state that, after much difficulty and delay in consequence of the limited appropriations made for the purpose, a contract was executed by the Department for the erection of light-houses at the following points, viz: Alcatras island, Point Conception, Battery point, Monterey, Faralones, Humboldt harbor, and San Diego, in the State of California, and at Cape Disappointment, in the Territory of Oregon. For each of the seven first named the sum of $15,000 was to be paid when completed and delivered into the possession of the United States, including the lantern and lighting apparatus complete, being the full amount appropriated by Congress; and for the other light-houses on Cape Disappointment the sum of $31,000 from the appropriation of $53,140 made for light-houses in Oregon.

For the faithful performance of this contract, the Department required good and satisfactory security to the extent of $75,000; but the contractor, after various attempts to make the needful arrangements for carrying the contract into effect, and to furnish the stipulated security, has been unable to do so; and the contract has, in consequence, been cancelled.
From all the inquiries made, and from the information received from those best acquainted with the subject, the Department is fully convinced that the high price of labor and materials in that quarter, in addition to the difficulties connected with the erection of buildings at some if not all of the locations, renders the amount appropriated by Congress entirely inadequate for the proper completion of these light-houses. No contract has or can be made for the other two light-houses at Cape Flattery and New Dungeness, in Oregon, for the balance of the appropriation, amounting to $22,140.

Since the above contract has been cancelled, the Department has renewed its endeavors, and made the needful inquiries, with a view to ascertain if another contract can be made on similar terms with responsible parties, who may be willing to enter into it, and who can give satisfactory security to at least the extent of $75,000, which large amount, under all the circumstances of the case, the Department would consider necessary, in order to insure the faithful performance of the agreement. Should it fail in accomplishing this, the Department had contemplated commencing the erection of the different buildings under the direction and superintendence of one or more officers of engineers of the Army, and to request of Congress the needful additional appropriation for the purpose of completing them.

In any point of view, it is both very desirable and important for the valuable commerce of that quarter that these light-houses should be erected with the least possible delay; but the Department greatly fears that this object cannot be obtained, either by contract or otherwise, in a suitable manner, without a large addition to the means which have been placed at its disposal for the purpose. The whole amount appropriated for seven light-houses on the coast of California and three on the coast of Oregon, including fog-signals and twelve iron buoys, is $158,140; and it is believed that proper and suitable buildings, with the lanterns and lighting apparatus, cannot be erected for much if any less than double that amount; and a still larger sum will be required if, instead of the ordinary lighting apparatus, with lamps and reflectors, the improved French lens should be adopted, and which the Department would recommend should be done. The present appropriation also contemplates fog-signals at four of the light-houses; but if Congress does not consider it advisable to increase the appropriation, not only must these signals be constructed on an inefficient scale, but the buildings and their appurtenances, with or without a contract, must necessarily be also on an inadequate and inefficient footing.

The Department believes that, in order to erect in a proper and suitable manner all the ten light-houses on the Pacific coast as directed by Congress, and to complete them with the needful machinery, appurtenances, and fixtures, a further appropriation of $150,000 will be required, and which it recommends should be made for the purpose.

I have the honor to be, very respectfully, your obedient servant,

THO. CORWIN,
Secretary of the Treasury.

Hon. WM. R. KING,
President pro tempore of the Senate.
Light-House Board.

Letter from the Secretary of the Treasury, transmitting a report from the Light-house Board, &c.

July 7, 1852.—Referred to the Committee on Commerce, and ordered to be printed.

Treasury Department, May 25, 1852.

Sir: I have the honor to transmit herewith a communication from the Light-house Board, dated 7th instant, in reference to the matters which, under the law, it was contemplated should come under their supervision.

Very respectfully, your obedient servant,

WM. L. Hodge,
Acting Secretary of the Treasury.

Hon. Linn Boyd,
Speaker of the House of Representatives.

Office Light-house Board,
Washington, May 7, 1852.

Sir: The very grave errors contained in the communication of the Fifth Auditor, entitled "A reply to the report of the Light-house Board," being calculated, unless exposed, to be injurious to the public service, we feel bound in duty to present the following report, and to request that it may be transmitted to the House of Representatives, to which the reply of the Fifth Auditor has been already communicated.

Passing over the attacks upon the action of the Treasury Department under former administrations, upon respectable citizens and officers of the Government, as wholly irrelevant to the subject, the board take issue with the Fifth Auditor, distinctly, upon the conclusions of his report.

They have proved in their report of January, 1852, and contrary to the specific allegations of the Fifth Auditor’s reply—

1. That the lights on our coast are not satisfactory to our captains of ships and pilots generally, but, on the contrary, that shipmasters who have been able to compare foreign lights with our own, naval officers, and pilots, are dissatisfied with them.

Nor are they satisfactory to the board, who, under the law, made their inspection of them.

But even if they were satisfactory to navigators, they should not be so to the Government or to Congress, since a greater amount of light can be had for less than one-half of the expenditure now incurred.

2. That the cost of the American lights of the same nominal class is but little less than that of Great Britain, while the quality is quite inferior.

In fact, if all matters relating to maintenance were fairly compared in both systems, the American lights would prove the most expensive.
In making his comparison, the Fifth Auditor has erroneously brought into the average cost of the American lights, all the beacons and harbor lights, lights with one lamp, two lamps, &c., and has compared these with the British sea-coast lights of the first class.

He has reckoned the pound sterling erroneously, swelling the cost of the English lights; and has included the cost of construction and repairs of some of the English light-houses and light-boats in the cost of maintenance, which greatly increases the previous erroneous estimate.

An estimate thus radically erroneous, is plainly entitled to no credit. The board have in their report of January, 1852, (p. 95, et seq.,) given as accurate a comparative estimate of the cost of American and foreign lights as it is possible to obtain, stating the different circumstances in the two cases.

3. That our light-boats are inferior to the British in all essential qualities, and especially in the lighting apparatus, which is antiquated and wasteful in the extreme.

4. That the inspection of oil is inadequate.

5. That the French lenses consuming but one-fourth of the oil used in our Argand lamps and reflectors, for the same amount of light, are more economical in the proportion of nearly four to one, and that the Trinity Board and the Scotch and Irish commissioners are now replacing their old reflectors by lenses in consequence of their greater efficiency and economy.

That in fact a sum of from $110,000 to $115,000 per annum, would be saved in supplies alone, with the existing number of lights in the United States, if the lens system were substituted for that now in use.

They have established the following important points, not noticed in the "reply of the Fifth Auditor:"

6. That there is a general want of system in every part of the Light-house Establishment of the United States, except that of the accounts; just such as must arise from a want of practical scientific knowledge in the director of it. It is plainly impossible to direct from a bureau at Washington, the light-house construction and illumination of an extended coast, no part of which is visited by the directing officer, who has, besides, no knowledge of the principles of optics, of chemistry, or of engineering.

7. That this defective organization leads to a waste in construction, in supply and in illumination, and that therefore, under a well organized system, the lights, beacons, buoys, &c., might be greatly increased in number and efficiency, at a large saving upon the present annual cost.

8. That the system of inspection and superintendence is insufficient; the illuminating apparatus nearly obsolete; the sea-coast lights defective in range and power; unclassified; without proper distinctions and without regulation.

9. That the coast is unequally lighted in different points, and there is no arrangement proposed by the Auditor by which this defect is to be remedied. The light-vessels are not kept in their places during seasons of the year especially dangerous to the navigator. There is no efficient
system for giving notices of changes in lights, beacons, buoys, &c., and
that in fact the Fifth Auditor himself is not made acquainted with these
changes.

10. That the buoys are defective in size, shape, materials, and mode
of mooring, and that there is no general list of them, with their posi-
tions, characters, &c.

That reform is needed in a system containing so many and such radi-
cal defects, is obvious.

Besides establishing in their report, the direct converse of the five
conclusions of the reply of the Fifth Auditor, the board prove in detail
the five other general propositions which have just been enumerated.
Of this proof, they invite the closest scrutiny by the Department and
by Congress; and to render it as easy as possible, propose, in the second
section of this report, to give a statement of the ten general propositions
which they establish, to refer as succinctly as possible to the detailed
propositions on which these rest, giving their numbers with reference to
the order in which they occur in the printed report of the Light-house
Board, of January, 1852, and references to the pages of the report and
appendix, where the facts and reasonings from which they are deduced
appear.

The board propose as a remedy for the defects thus found to exist in
the present organization and system, a plan which offers:

1. An efficient organization without additional cost.
2. Economy and efficiency in selecting sites, constructing light-houses,
light-boats, and selecting illuminating apparatus, and in supplies.
3. A great saving in the cost of superintendence, with a certainty
that it will be efficient, because professional.
4. A very great saving in the cost of illumination, repairs, &c.

SECOND SECTION.

CONTAINING THE PROOFS OF THE TEN FOLLOWING PROPOSITIONS ESTAB-
LISHED BY THE LIGHT-HOUSE BOARD:

1. That the lights on our coast are not satisfactory to captains of ships
and pilots generally, as asserted by the Fifth Auditor. (Pp. 20, 28, 29,
206 to 261, public documents in appendix to Light-house Board report,
and in Appendix B to this report.)

2. That the cost of the lights of the United States, of the same class, is
but little, if any, less than those of Great Britain, while their quality is
greatly inferior.
§ 2, p 8. That the light-house establishment of the United States does
not compare favorably in economy with those of Great Britain and France.
§ 3, p. 8. The difference for maintenance per lamp is very small and
that not invariably in favor of the lights of this country.
§ 1, p. 8 That the lights, &c., of the United States are not as effec-
tive as the interests of commerce, navigation, and humanity demand, and do
not compare favorably with similar aids to navigation in Europe in general.
(Pp. 20, 80, 95 to 100, 170, 204 to 261, &c., public documents at
end of Light-house Board report, and Appendix B to this report.)
3. That our light-boats are inferior to the British in all essential qualities and especially in the lighting apparatus, which is antiquated and wasteful in the extreme.

§ 38, p. 10. Are comparatively useless for want of efficient lamps and parabolic reflectors.

§ 34, p. 10. Are defective in size, model, and moorings.

§ 35 and 36, p. 10. Are not properly designated by day or night. (Pp. 35, 50, 96, 97, 174, 196, 206 to 257, 261 to 281, and letters of Jacob Herbert, Esquire, Lieutenant William Lord, R. N., &c.)

4. That the inspection of oil is inadequate. (Pp. 23, 25, 61, 171 to 204, 283 to 285, 288, 292, &c.)

5. That the French lenses are more economical than reflectors, in the proportion of nearly four to one, and that, in consequence of their greater efficiency and economy, the Trinity Board is now replacing their old reflector lights by the lens lights. (Pp. 13, 23, 25, 27, 79 to 92, 119, 206 to 261, 303, 307, 315, 321, 324, 338 to 341, and letters of Alan Stevenson, Esquire, Jacob Herbert, Esquire, M. Leonor Fresnel, M. L. Reynaud, and public documents in Light-house Board report, also in the appendix to this report.)

6. That there is a general want of system in every part of the establishment, except that of accounts, such as must arise from a want of practical scientific knowledge in the director of it.

§ 61, p. 11. There is no system in the management of the light-house establishment of the United States. (Pp. 20 to 41, 48 to 67, 104 to 127, 170 to 204, 261 to 282, 288 to 298, &c.)

7. That this defective organization leads to waste in construction, in supply and in illumination, and that therefore, under a well organized system, the lights, beacons, buoys, &c., might be greatly increased in number and efficiency, at a large saving on the present annual cost. (Pp. 20 to 29, 79, 118 to 123, 170 to 204, and letter of general superintendent of lights.)

Construction.—§ 4, p. 8. The towers and buildings are defective in materials, and have not been constructed by competent and faithful engineers. (Pp. 22, 27, 52, 53, 68, 109, 113, 148, 170 to 204, 262, 265, Executive document No. 14, second session thirty-first Congress, and public documents in Light-house Board report.)

§ 5, p. 8. These defects have been verified by the board. (Pp. 22, 27, 135, 170 to 204)

§ 6, p. 8. The extensive repairs and renovations required, are the result of the non-employment of competent persons to plan and construct the buildings. (See annual estimates and appropriations, and pp. 52, 53, 68, 170 to 204.)

§ 7, p. 8. The towers and buildings are defective. (Pp. 170 to 204.)

§ 8, p. 8. The lanterns and other accessories are also defective.

§ 9, 10, p. 8. And without proper ventilation. (Pp. 23, 30, 170 to 204.)

§ 11, p. 9. Not properly painted. (Pp. 22, 170 to 204.)
§ 14, p. 9. Unsuited to the service and locality. (Pp. 16, 132 to 142, 170 to 204.)
§ 31, p. 10. That contractors are not held under sufficiently rigid superintendence, &c.
§ 32, p. 10. That some of the modern light-houses are inferior in point of materials and workmanship to older ones. (Pp. 170 to 204, and letter of general superintendent of lights, &c.)
§ 75, p. 12. That competent engineers have not been employed to plan and superintend the construction, &c. (See notes of inspection, pp. 170 to 204.)
§ 76, p. 12. The large amounts required annually for repairs, &c., is attributable to the manner in which the work is executed and the materials employed. (Pp. 170 to 204.)
§ 77, p. 12. Large sums now required to preserve foundations, &c., might have been saved by the adoption of proper plans and foundations for them. (See annual estimates and appropriations, and notes of inspection of Light-house Board, p. 170 to 204.)
§ 78, p. 12. No systematic and economical plan of construction has been employed. (Pp. 269 to 282, and notes of inspection of Light-house Board, pp. 170 to 204.)
§ 13, p. 9. That there never has been an efficient and systematic plan of construction, illumination, inspection, and superintendence, &c., in the United States. (See letter of general superintendent of lights, &c., notes of inspection, &c., pp. 170 to 204.)
Illumination.—§ 16, p. 9. That the illuminating apparatus is inferior, requiring costly repairs and frequent renewal, and is ineffective at best. (Pp. 170 to 204, 269 to 282.)
§ 17, p. 9. Is defective in form, material, and finish.
§ 26, p. 9. Is not made under competent professional supervision. (Pp. 170 to 204, 269 to 289, letters of general superintendent, collector of Boston, &c.)
§ 18, p. 9. Is of a kind which is nearly obsolete, having been superseded by the Fresnel lens. (Letters of Messrs. Fresnel, Reyneau, Jacob Herbert, and Alan Stevenson, appendix to Light-house Board report, &c.)
§ 19, p. 9. That the sea-coast lights are defective in power and range. (Pp. 204 to 262, and Appendix B to this report)
§ 47, p. 10. And those south of the Highlands of Navesink are comparatively useless for the same reason. (Pp. 206, 212, 216, to 262, 315 to 327, &c., and Appendix B to this report.)
§ 20, p. 9. The reflector sea-coast lights are not sufficiently powerful. (Pp. 204 to 262, 315 to 327, and appendix to this report.)
§ 21, p. 9. Are placed without regard to divergency. (Notes of inspection, pp. 170 to 204.)
§ 33, p. 10. Many of the small lights have too many lamps, and the sea-coast lights have too few. (Notes of inspection, pp. 170 to 204, list of lights, &c.)
§ 89, p. 10. The forms and adjustments of the reflectors are not made according to scientific principles. (See notes of inspection, pp. 170 to 204.)
§ 40, p. 10. That in effect there is not a single first-class light on the coast of the United States. (Pp. 42, 44, 170.)

§ 41, p. 10. The Navesink lens lights and Sankaty Head second-order lens are the best lights on the coast. (See letters, Appendix B, &c., pp. 206 to 262, 303 to 315, 321 to 327, 338 to 341.)

§ 42, p. 10. There are few, if any, reflector lights on the coast of the United States better, in useful effect, than the third-order lens light, larger model, on Brandywine shoal. (Pp. 28, 29, and letters from captains of vessels.)

§ 44, p. 10. The Fresnel lens is greatly superior to any other mode of light-house illumination. (See reports of M. Leonor Fresnel, Executive document No. 488, first session twenty-ninth Congress, Alan Stevenson and Trinity Board returns, letters from MM. Reynaud and Fresnel, report of Royal Society of Edinburgh, Scotland, appendix to Light-house Board report and to this report.)

§ 74, p. 12 That light-house construction, illumination, inspection, and superintendence, involve a large amount of general professional knowledge of a high character, and therefore should only be intrusted to the most competent professional persons (See letters to Sir David Brewster, M. Fresnel and M. Reynaud, Mr. Alan Stevenson, &c.)

SUPPLIES.—§ 28, p. 9. That supplies of all kinds are not selected and properly tested before delivery.

§ 29, p. 9. That there is not proper responsibility on the part of agents connected with the light-house establishment. (Pp. 21, 22, 23, 24, 25, 26, 27, 28, 29, 170 to 204, 271, 278, 283, 285, 288, 292)

§ 30, p. 9. That the present mode of procuring and distributing supplies, apparatus, &c., is not calculated to insure either efficiency or economy. (Pp. 79, 285, 288, 292.)

§ 57, p. 11. The supplies of oil, chimneys, wicks, &c., are not properly and carefully tested.

§ 58, p. 11. There is no proper system of distributing supplies.

§ 59, p. 11. And no proper attention paid to their purchase.

§ 60, p. 11. The cleaning powder for the reflectors is not of the right material, and other articles are equally defective. (Pp. 61, 64, 170 to 204, 285, 288, 292, and letters of Jacob Herbert, Esquire, and Alan Stevenson, Esquire.)

§ 66, p. 11. The supplies are not delivered at proper intervals of time. (Pp. 170 to 204, letter of general superintendent of lights, and also from Captain Howland.)

8. That the system of attendance inspection, and superintendence is inefficient; the illuminating apparatus nearly obsolete; the sea-coast lights defective in range and power; unclassified; without proper distinctions, and without due regulation. (Pp. 30, 36, 37, 41, 42, 44, 45, 46, 69, 86, 87, 134, 141, 170 to 204, 206 to 260, 269 to 327, 338 to 341.)

§ 22, p. 9. The attendance of one keeper is not sufficient for a sea-coast light. (Letters of M. Fresnel, M. Reynaud, Jacob Herbert, Esquire, Alan Stevenson, Esquire, and the Fifth Auditor on p. 14 of his reply.)

§ 13, p. 9. No efficient system of inspection and superintendence has ever existed in the United States.
§ 25, p. 9. Nor does any moderately useful or efficient system now exist. Notes of inspection, pp. 170 to 204, 269 to 274, 276 to 283, 289 to 298."

§ 64, p. 12. That frequent and rigid inspections and superintendence by competent persons are necessary. (Stevenson, Herbert, Fresnel, and Reynaud, in appendix to Light-house Board report.)

§ 74, p. 12. That light-house construction, illumination, inspection, and superintendence, involve a large amount of special and general professional knowledge of a high character, and therefore should only be intrusted to the most competent professional persons. (See Stevenson, Reynaud, Fresnel, Herbert, Walker, and others, Parliamentary report, 1845, and Skerryvore light-house, Executive document No. 488, first session twenty-ninth Congress.)

§ 18, p. 9 The reflectors are giving place in other countries to lenses, on account of the superior brilliancy and economy of the latter. (Pp. 7, 69, letters of Stevenson, Herbert, Fresnel, Reynaud, Lepaute, and Le-tourneau, in appendix to Light-house Board report.)

§ 19, p. 9. The range and power of sea-coast lights is inadequate. (Pp. 206 to 260, and Appendix B to this report.)

§ 23, p. 9. There is no proper system of classification of lights. (Pp. 269 to 282.)

§ 24, p. 9. There are no sufficient distinctions to prevent one light from being mistaken for another. (Pp. 42, 44, 45, 46, 47, 184, 189, 141, 142, 206 to 262, 269 to 282.)

§ 27, p. 9. There are no adequate general or special rules for keepers, etc., to insure a faithful performance of the duties. (See instructions to light-keepers in this country and in Europe, in appendix to Light-house Board report.

§ 56, p. 11. That in many cases the keepers are not incompetent. (Pp. 170 to 204, 269 to 282.)

§ 62, p. 11. The instructions to keepers in regard to trimming, lighting, and extinguishing lights are not enforced. (Pp. 170 to 204.)

§ 63, p. 11. Such knowledge is not imparted to keepers, as a general rule, to enable them to keep their lamps, etc., in such order as to insure the best lights. (Pp. 170 to 204, 269.)

§ 65, p. 11. To insure good lights at all times, competent keepers and a proper system of inspection are necessary. (See letters of Fresnel, Reynaud, &c., in appendix to Light-house Board report.)

§ 71, p. 12. That the erection of light-house towers without regard to the exigencies of the service, is contrary to the first principles of light-house engineering. (Pp. 105, 269, &c.)

9. That the coast is unequally lighted in different points, and there is no arrangement proposed by the Auditor to remedy this defect. The light-vessels are not kept in their places during seasons of the year especially dangerous to navigation. There is no efficient arrangement for giving notice of changes in lights, beacons, buoys, etc., and that in fact the bureau does not know when these changes are made.
§ 50, p. 10. There is no systematic plan for rendering navigation easy, by means of lights, beacons, buoys, &c. (Pp. 46, 50, 67, 104, 105, 125, 147, 148, 170 to 204, 206 to 261, 269. &c.)

§ 51, p. 11. Lights and other aids to navigation are provided, as a general rule, only through the action of Congress on petitions emanating from local interests. (See letters of Fifth Auditor in Appendix D to this report.)

§ 52, p. 11. Under a proper organization the officers of the Light-house Establishment would collect information from reliable sources, decide upon doubtful points, and recommend to Congress cases requiring appropriations. (See organization of European Light-house Establishments.)

§ 49, p. 10. That the entire southern coast of the United States requires additional lights, &c. (Pp. 125 to 131, 204 to 260, and Appendix B to this report.)

§ 48, p. 10. The dangerous reefs and shoals of the Florida coast are not properly lighted or marked. (Pp. 204 to 260, 313 to 327, and Appendix B to this report.)

§ 53, p. 11. The approaches to some of our most important harbors, &c., are not sufficiently lighted and marked to render steam navigation as rapid, easy, and safe as the wants of commerce demand. (Pp. 125, 126, 127, 128, 204 to 260, and appendix to this report.)

§ 54, p. 11. It is obvious that the duty of lighting and marking our extended coasts can only be performed efficiently and economically by persons of professional experience. (See organization of European Light-house Establishments, pp. 69 to 76, letters of Alan Stevenson, Esquire, Jacob Herbert, Esquire, M. Leenor Fresnel, M. Reynaud, &c.)

§ 73, p. 12. For want of a proper system, densely-populated coasts have a superabundance of lights, while on sparsely-settled coasts there is not a sufficient number. (See account of southern coast, pp. 125, 204 to 260.)

§ 68, p. 11. That the removal and placing of light-vessels, extinguishment or lighting of lights, removal or replacing of buoys, &c., without giving ample notice, are subjects of grave complaint. (Pp. 204 to 260.)

§ 69, p. 12. There is no good reason why the light-vessels of the United States should not remain at their moorings under as unfavorable circumstances as those on the coast of Great Britain and Ireland. (Pp. 204 to 260.)

§ 70, p. 12. Whenever light-vessels are reported to have parted their moorings, every circumstance attending them should be carefully investigated.

§ 79, p. 12. Changes are constantly taking place in the aids to navigation, without official notice of them being given to the public. (Pp. 204 to 260.)

§ 81, p. 12. The list of light-houses and light-vessels is defective in many respects. (See official list of 1851.)

§ 82, p. 12. That there is no regular systematic or effective mode of giving notice to mariners of proposed changes in lights, &c. (Pp. 269, 204 to 260.)

10. That the buoys are defective in size, shape, material, and mode of
THIRD SECTION.

The board would call attention also, to the following errors contained in the reply:

1. The lens lights at Navesink were not procured by the Fifth Auditor but by Commodore Perry, and the service has been so organized by the Auditor as to make them unnecessarily expensive.

2. The quantity of oil consumed at Navesink is stated in the Fifth Auditor’s reply at 1,132 gallons, whereas the board found it to be, from the keeper’s books, 936 gallons. An equivalent reflector light would consume 2,800 gallons of oil, making a saving by the use of the lens light of $2,400 per annum for oil. The cost of repairs of lamps in the lens system is the less. The number of keepers for a properly organized service is the same.

3. The comparison made in the “reply,” of lens and reflector lights is very erroneous. The Sandy Hook reflector light is compared with the Navesink lens lights in brilliancy, while the Navesink lens lights give between five and six times the light of the Sandy Hook reflector light. The Sandy Hook light (exclusive of the beacons) consumed seven hundred and twenty gallons of oil per annum, and an equivalent lens light would consume but three hundred and eighty-four gallons.

The following errors occur in the reply, in the comparative estimates of lens and reflector lights:

4. French kilogrammes of oil are converted into gallons by an erroneous rule. A first-order lens light is thus made to consume $840\frac{3}{4}$ gallons of oil a year, instead of five hundred and seventy gallons.

Four keepers are erroneously allowed to a lens light instead of two, the number employed in England, Ireland, and Scotland.

The salaries of the keepers of reflector lights are erroneously given as three hundred and fifty dollars and two hundred and fifty dollars, which is much below the amounts actually paid, while those for lens lights are put at six hundred dollars, and their assistants at three hundred and sixty dollars, when in fact there should be no difference in the salaries. See Appendix A.

The attempt in the “reply” to set down a first-order lens light as merely equivalent to, or giving the same amount of light as seventeen Argand burners, is entirely erroneous.

For a fixed light the economy in favor of a first-order lens is between two and three to one, as compared with reflectors, and for a revolving light as four to one.

The consumption of oil by a second-order lens light is erroneously stated at five hundred and sixty-eight gallons and a half instead of three hundred and eighty-four, the consumption of the Scotch and English lights of this order, and within ten gallons of that at Sankaty Head, Nantucket.

Three keepers are estimated as necessary for a lens light of the second order, whereas two only are required for its full service.
The economy of oil in a second-order lens, for a fixed light, compared with reflectors for the same amount of light, is as upwards of three to one in favor of the lens, and for a revolving light as four to one.

The oil consumed by a third-order lens light is stated at two hundred and twenty-four and a half gallons, whereas it is in Scotland, for the larger model of this order, one hundred and eighty-three gallons, and for the smaller one hundred and thirty gallons. The economy is, for oil alone, nearly three and a half to one in favor of the lens light of this order over the reflector.

It is a great error to consider a light with six lamps and reflectors as comparable with a lens light of this order. The comparison, made by the board, of the third-order lens light on Brandywine shoal and the reflector lights at the capes of the Delaware, confirm this.

Two keepers are not required in general for this order of lens light, contrary to what is assumed in the reply. The labor and care necessary to keep the lens lights in proper condition is very much less than for equivalent reflector lights.

The oil consumed by the single lamp of a fourth-order lens light is set down at sixty-nine gallons, while that by the same lamp in the focus of a reflector is called thirty-five gallons.

In the reply it is forgotten that a single lamp surrounded by the concentric rings of the lens system illuminates seven-eighths of the whole horizon, and when placed in the focus of a reflector, only one thirty-third part of it.

The salary of a keeper for the lens light of the fourth-order is set down at four hundred dollars, and for the reflector light at three hundred and fifty dollars.

The two smallest classes of lens lights with an Argand or Corel lamp with a single wick, are superior to the reflector lights in useful effect, and are more economical in the ratio of the number of lamps used in the reflector lights to one. Hence such should be used for harbors, bays, rivers, &c., while a range of only ten to twelve miles is required.

The estimates of the reply, being thus radically in error, are worse than valueless.

5. Experience proves that any keeper capable of the charge of a revolving light can manage a lens light. It is an error, already disproved by facts, that Americans cannot be obtained capable of keeping such lights. No difficulty has been found in the case of the five lens lights already existing in the United States, though the requisite pains were not taken to instruct the keepers.

6. The comparison of the number of hours during which the lights are kept burning in the light-houses of the United States and of France, is erroneous. The lights in the United States are not, as a general thing, kept burning from sunset to sunrise, as supposed in the reply. There are eighty-three lights on the lakes and northern rivers with five hundred and ninety lamps, which are not lighted at all during about one-third of the year.

7. It is a great error to state, as is done in the reply, that "in France a great proportion of the lights are harbor lights, and lit up for a few hours only each night." On the contrary no country has so large a
proportion of lights of the higher orders as France. In one hundred and sixty-six lights there are sixty of the first three orders.

8. The comparison of the ranges of reflector and lens lights is exceedingly erroneous. The distance at which the French lights are set down in their list to be visible, is reduced to the minimum calculated distance, while in the Fifth Auditor’s list there is great exaggeration. For example, Cape Griznez light, on the French coast, is set down as visible at eighteen miles, while it is seen at Dover pier, twenty miles distant, as if close by; and the Navesink lights in New Jersey are said to have a range of thirty miles, while the roundness of the earth would prevent it from being seen more than twenty-two miles from the deck of a small vessel. The elementary principles of computation are obviously not understood.

9. The average annual cost of maintaining our lights, including the small ones with one lamp, two lamps, &c., is stated in the reply at $1,098 34, while it has been proved by the board to be $1,135 72. The cost of maintaining a light of seventeen lamps is set down at $1,195, while in reality it is upwards of $2,000.

In one of the best-kept districts of the United States last year, the cost of maintenance per lamp was $170.37, and per light-house $1,518, although only four out of twenty-three lights are on the sea-coast.

The average cost of maintaining a light-boat is set down in the reply at $2,888 89. In the letter from the Fifth Auditor to the Light-house Board, it is stated to be “three or four times the annual expense of a light-house of the first class.”

10. The reply takes different ground in regard to the lens lights from that in a letter to the Light-house Board. In the one the Fifth Auditor says, “I have been opposed to the introduction of any of them (lenses) except the flashing light of the second order, which is useful as a distinguishing light;” and in the other, “believing that if any of the lenses could be employed with advantage in our light-houses, it would be those of the third order.” What value can be placed upon opinions thus changeable?

11. The comparison of the cost of American and English lights is rendered valueless by errors of principle as well as of fact. The Trinity House lights alone are taken for comparison, omitting all the Scotch and Irish lights and those of English corporations, which include harbor and other local lights generally.

In the estimate of annual cost of maintenance of these lights, the reply includes sums actually expended for the construction and rebuilding of light-houses and light-boats; procuring buoys, inspection, superintendence, interest on purchase money of lights, and the like.

An equality with these lights is assumed for ours, whereas even our sea-coast lights are very inferior to them. To compare river and harbor lights with sea-coast lights is, of course, a great error.

The number of keepers in the English lights is greater than those of the United States.

The Trinity House lights are nearly all sea-coast lights, forty-five out of sixty-eight being first-class sea-coast lights, thirteen secondary lights, and only ten smaller lights. On the contrary, of the United States
lights, only fifteen out of three hundred and thirteen have more than fifteen lamps and reflectors.

In the United States the cost of rebuilding light-houses and light-boats is not charged with the annual cost of the lights, but is provided for in separate appropriations.

With us the inspection, &c., of lights is generally connected with the collection of customs and charged against the collection of the revenue.

In the number of our lights are included all grades and classes; as, for example, nine without reflectors, seven with only one lamp, seven with two or three lamps, nineteen with only four or five lamps, and so on.

To average the cost of keeping such very unequal lights is not less erroneous than it would be to compare the cost of maintaining vessels, by taking coasters for one average and heavy merchant ships for the other.

In these comparative estimates the value of the pound sterling is erroneously assumed.

12. In comparing the annual cost of lights in the United States and foreign countries, the reply omits the ruling datum of the number of lamps for each light. The Trinity House lights have nearly fifty per cent. more lamps per light than the United States, with about the same difference in cost per annum.

13. The expense of inspection, local superintendence, &c., must also be deducted from the estimates of the cost of the Trinity House lights contained in the reply. The oil used for the Trinity House lights in 1846 (the year taken in the reply for comparison) cost one dollar and fifty-five cents per gallon, while that for our lights cost but little more than one dollar per gallon.

When these necessary data are introduced into the comparison, the Trinity House lights are but little more expensive than those of the United States, while they are much more effective. For the Scotch lights there are one hundred per cent. more lamps for eighty-five per cent. more cost. For the Irish lights, one hundred and fifteen per cent. more lamps for fifty per cent. greater cost.

14. An accurate comparison of the cost of the French sea-coast lights and of our own, shows that our best reflector lights of eighteen lamps and reflectors cost upwards of two thousand dollars per annum for maintenance, with, as a general rule, only one keeper, and the French first-order lens lights, which are better than thirty-six lamps and reflectors, with three keepers, average only $1,308 34 per annum.

15. The quotations from the testimony of Captain Moore, Captain Washington, and the committee of the elder brethren of the Trinity House contained in the reply are incomplete; important portions and an all-important date being omitted, and give, therefore, an erroneous view of the subject. The views of the Trinity House officials in 1836 are quoted in the reply, as conclusive now against reflector lights, when experience has changed them so entirely that the corporation has for several years been gradually converting all the reflector lights into lens lights, and is now actually engaged in making such changes. (See appendix to Light-house Board report, page 482, et seq.)
All the testimony of Captain Moore, of the packet ship "Hendrick Hudson," and of Captain Washington, R. N., reported in the proceedings of the select committee of the House of Commons of 1845, relating to light-houses of this country and of Great Britain, will be found in the appendix to this report, unabbreviated.

6. The positions taken in the reply that the old torch-light or gimbals, as used in our light-boats, is superior to the modern Argand lamps and reflectors, also on gimbals, is contrary to all reason and experience. The same is true of the position, that two masts do not cut off more light than one. (See appendix to Light-house Board report, page 432, et seq.)

17. The comparison of the cost of light-boats in the United States and in England, is vitiated by similar errors to those in regard to light-houses. The important consideration of the exposed positions of the English vessels is omitted. The cost of our own vessels is erroneously stated.

The cost of the Sandy Hook light-boat is nearly nine thousand dollars, and that of the Five-Fathom bank about five thousand dollars, instead of the average estimated in the "reply," (the two light-boats being in most exposed positions on the coast.)

18. Thirty-four light-houses in the United States have been rebuilt; four, built in 1838, 1839, and 1847, have fallen down within the last six months, and there are petitions now for rebuilding others. Eighty-seven retimements have been made, and in some cases the apparatus has been twice replaced in ten years.

19. The reply shows that the light at Craney Island, was so defective that a change of color was recommended on account of the difficulty of distinguishing it from the lights of vessels (common lantern lamps anchored near it). Such lamps consuming about one-tenth or one-eighth as much oil as the Craney Island light.

20. The very defective arrangement of our lights in regard to distinction appears from the following examples:

Sankaty Head and Gay Head, both revolving lights, are distant from each other only thirty-nine miles.

Pensacola and Mobile Point, also revolving lights, are distant from each other only thirty-eight miles.

This arrangement of the distinguishing characteristics of these four lights is most exceptionable, and it is a striking illustration of one of the conclusions of the board.

There could be no good reason for leaving these lights without better distinguishing characteristics under any circumstances; but, with only thirty single revolving lights out of three hundred and sixteen on the entire coast of the United States, it is unaccountable how so grave an error could have been originally committed.

21. The very defective arrangement of the following lights is a further illustration of the inefficiency of the present management:

Gay Head, one of the most important of our sea-coast lights, both for coasting and over-sea voyages, has only ten 14-inch reflectors, while
Little Gull Island, Long Island Sound, Galloo Island, Lake Ontario, Robbins Reef, New York Harbor, and New Point Comfort, Chesapeake bay, have each fifteen lamps and 14 and 16-inch reflectors. Portsmouth Harbor light, thirteen 15-inch reflectors; Whalesback light, entrance to Portsmouth harbor, New Hampshire, has fifteen 15-inch reflectors; Nantucket light, fifteen 21-inch reflectors; Bodkin Point Thomas’s Point, and Pool’s Island, in upper part of Chesapeake bay, have each thirteen lamps and 15, 16, and 16½-inch reflectors. Oswego, on Lake Ontario, has thirteen 14-inch reflectors; Eaton’s Neck, thirteen 15-inch reflectors; and Execution Rock thirteen 21-inch reflectors, although merely sound lights; and the little harbor light at Baltimore has eleven lamps and 15-inch reflectors, while Cape Hatteras, probably the most important light on the coast, has only fifteen 21-inch reflectors much worn; Cape Lookout, another important light, has only thirteen 21-inch reflectors, Tybee only fifteen 16-inch reflectors, Cumberland island the same, &c.

The Charleston light is revolving, which renders it difficult for vessels to cross the bar at night by it in consequence of the eclipses occurring at the time when the mariner requires a steady and brilliant light.

Many other cases might be pointed out, if it were necessary, to prove the total absence of knowledge and system in the management of our lights.

22. The reply, by admitting that Congress is obliged to legislate in relation to light-houses without estimates from the superintendent, confirms what the board has stated in relation to the inefficiency of the organization. (Letters from Fifth Auditor in Appendix D, &c.)

23. This inefficiency is fully shown in the statements made as to the examination of a particular site. Had the necessary steps been taken by the Fifth Auditor to obtain the information essential to a correct decision of the question at issue, by a proper survey and suitable instructions, no such mistake would have been possible.

24. The very reverse of what is stated in the reply to have been proved by M. Fresnel in regard to the relative cost of lens and reflector lights, has really been proved by that distinguished savant. So in regard to the labors of the Trinity Board and Scotch Commissioners. In the fact of the superior economy of the lens light in the proportion of three and a half and four to one, Mr. Stevenson, the engineer of the Scotch lights, agrees with M. Fresnel.

25. As lens lights will enable us to save three-fourths of the expense of supplies every year, it will be well to purchase them, though made in France. We cannot tell how soon American ingenuity may produce them, if turned towards their manufacture.

26. The reply furnishes no evidence to disprove the conclusions of the board, that the oil is not subjected to proper inspection and test. On the contrary, it is shown that the required tests are inefficient. Instead of requiring the oil to remain limpid at temperatures of only 82° and 45° of the thermometer, the best sperm oil should remain limpid at a temperature of 28° of the Fahrenheit thermometer, independently of other tests.

If, as it is asserted in the reply, the keepers who complain of the oil
neglect their lamps, it is only additional evidence of the necessity for a
more rigid and efficient inspection and superintendence.

A sufficient answer to the letters and certificates appended to and form-
ing a part of the reply of the Fifth Auditor, will be found in a careful
perusal and examination of them.

The reference to coal lights, to the light at Craney island, and the fact
stated in one instance that “very few signed without first reading it,”
prove conclusively that on a subject of this kind such testimony has no
real value.

Having shown that such testimonials, letters, certificates, &c., as those
appended to the reply, possess no intrinsic value in reference to a subject
involving the varied scientific, professional, and special considerations
this does, it is barely necessary to refer again to a part of the positive
evidence in the possession of the board, which disproves the assertions
contained in the reply of the Fifth Auditor.

The board have examined personally a sufficient number of our own
lights, and conversed with a sufficient number of the most intelligent
seafaring men and pilots, to satisfy them that our lights are far from
being “satisfactory to our captains of ships and pilots generally.”

They have already appended to their report a large number of letters
from the most intelligent commanders of sea-steamers, packets, and other
ships making over-sea voyages, &c., in addition to those which will be
found hereto appended, (Appendix B,) which contain overwhelming
proof of the correctness of the conclusions of the Light-house Board,
and in direct opposition to those of the reply.

It is due to those intelligent seamen to state that their opinions are
given in their own language, and no communication received by the
board has been omitted.

The Fifth Auditor in his reply says, (page 15, under note;) “The
colza or rape-seed oil recommended for use in our light-houses, like all
vegetable oils, becomes thick and unfit to burn in a short time.” He
does not give his authority for this assertion, though he has never experi-
mented with the oil, and it is probable that he has never seen a gallon
of it.

Professor Faraday and Mr. Stevenson, whose reports have been laid
before Parliament long since, have proved that the colza oil is not only
cheaper than the sperm oil, but that it remains limpid at a lower tem-
perature, burns from three to four times as long as sperm without
requiring to be trimmed and without any perceptible diminution of light,
and produces a whiter light. The small difference of consumption per
night in favor of sperm oil is made up by an increased quantity of light
in the ratio of the increased consumption of oil.

But the colza oil is not now a product of our country, and it will be
time to discuss this question when our farmers turn to the cultivation of
the plants which yield it. Nor will those who are concerned in our
whale fisheries suffer by such a substitution, for the supply of sperm oil
is now entirely inadequate to meet the demand for steam uses, in which
it has the decided preference. Only those will be affected, if such there
are, who expect to make a profit from an adulterated article, sold instead of the pure oil.

Very respectfully submitted.

By order of the Light-house Board:

W. BRANFORD SHUBRICK,
President.

THORNTON A. JENKINS, Secretary.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

APPENDIX.

As the Fifth Auditor has quoted an extract from the diary or report of the deputy master and a committee of the Elder Brethren (Trinity House corporation, London) of 1836, without giving the year, who came to the conclusion "that they were so exactly alike that it was almost impossible to discover any difference; if there was any, we thought the light from the reflector rather the largest, that from the refractor rather the whitest;" let us see what the committee of the Royal Society, (Edinburgh,) appointed to co-operate with the Commissioners for Northern Lights, reported on the 26th of October, 1836, say in their report on the same subject and with the same lights at the Isle of May:

"The committee were requested to compare the new fixed dioptric light on the Isle of May, thirteen miles distant, with the old catoptric light, placed on a temporary erection near it. From the first point of observation, near the town of Dunbar, the committee were unanimous in pronouncing the great superiority in effect of the new light, which appeared brighter than the old one, in the rates of not less than four or five to one. But upon changing the position of the point of observation to the eastward, the difference became less marked and at a distance (from the first station) of about one and a half mile, was scarcely appreciable, though the new light appears whiter and somewhat better defined. The reason of this prodigious difference of the old light in different azimuths, Mr. Alan Stevenson, the assistant engineer, explained to be, that since the divergence of the reflected beam is produced by placing the lamp a little out of the focus of the mirror, the central pencil of reflected light is much less scattered than the lateral pencils which in an azimuth exactly intermediate between the axes of two adjacent reflectors, is very feeble indeed. The evening of the 26th was neither remarkably clear, nor remarkably the reverse, and the members of the committee were satisfied that a slight increase of haze would have rendered the old light wholly invisible at the town of Dunbar, which appears to be placed (in the present temporary position of the reflecting system) in the line of least illumination.

"The number of mirrors in the old system being twenty-four and the divergence given to the reflected light 15', a certain portion of light is thrown all around the horizon, but the intensity in different directions
varies (as has been said) prodigiously. The divergence of $15^\circ$ in a vertical plane also taking place as a necessary consequence of this method of expanding the reflected beam, by unfocusing the lamp, produces a useless and most injurious expenditure of light in directions in which it can never be seen. On the other hand, the dioptric system of hoops, besides the great advantage obtained by substituting refraction for reflection (from the less loss of light) rigorously fulfills the requisite geometrical condition of spreading a plane of light, exhausting the whole available light of the lamp of precisely equal intensity in all directions. This has never been attempted by any combination of reflectors.

"The distance of the Isle of May from Dunbar being thirteen miles, the range of one mirror of the old system extending through about $15''$, would not differ much from a linear distance of three miles in a direction perpendicular to a line joining Dunbar and the May."

"The space between maximum and minimum light would therefore be about a mile and a half. The space walked over must have nearly included a complete series of the variations of the light. Assuming the average light of the mirrors at half that of the dioptric light (which certainly does not seem too much) we have a superiority of two to one in favor of the latter at a distance of thirteen miles. These are to be considered, however, but as rude ocular estimations."

"But it is not to be inferred that the ratios of the intensities of the two systems will remain the same at all distances. Were the refracted light in one plane (instead of having a virtual divergence of $6^\circ$) and were the reflected light comprised within a cone uniformly illuminated (which is not the case) the light from the first would vary inversely as the distance, from the second inversely as the square of the sum of the distance and a constant which depends upon the divergence; but neither of these conditions being fulfilled, the reflective illuminations must vary with the distance according to two other distinct laws, each much more complicated. It is clear, therefore, that the comparison made at one given distance will not apply to any other given distance. But still the effect of distance in modifying intensity, may be much more accurately estimated in the case of the prismatic than of the reflecting arrangement."

"The following conclusions seem to be warranted:

1. That at a distance of thirteen miles, the mean effect of the new light is very much superior to the mean effect of the old light, (perhaps in the ratio of two to one.)

2. That at all distances the new light has a prodigious superiority to the old, from the equality of its effects, in all azimuths.

3. That the new light fulfills rigorously the conditions required for the distribution of light to the greatest advantage.

4. That at distances much exceeding thirteen miles, the new light must still be a very effective one, though to what extent the committee have not observed. The light is understood to be still a good one, when seen from Edinburgh, at a distance of about thirty miles.

"GREENOCK, V. P. R. S., Edinburgh.

"JOHN ROBISON, Secretary R. S., Edinburgh.

"THOMAS STEWART TRAILL.

"R. CHRISTIAN.

"JAMES D. FORBES, Reporter."
Extracts from the reports of the engineer to the Scotch lights commissioners, dated October 27 and November 25, 1835, on the new dioptric light of Inchkeith, (the first lens light introduced into Scotland.)

"On the evening of the first of October a new light, on the dioptric principle of Fresnel, was exhibited at Inchkeith, in place of the reflected light, which was finally discontinued on the night of the 30th of September. Since that time repeated observations have been made upon the new light from different distances and elevations, under the varying circumstances of clear and foggy weather; and, before the extinction of the former light, numerous opportunities occurred of comparing the relative powers of the two lights, which were shown in contrast at the same hour every night for some weeks. Before proceeding, however, to notice the results of these observations, I shall briefly describe the apparatus itself, which belongs to the second order of the French system.

The lamp, which has three concentric wicks, is in every particular the same as that employed in the lights of the second order on the French coast. The light itself exhibits the same general characteristics as the reflected light, being distinguished by flashes recurring once a minute. These flashes are caused by the revolution of a rotary frame which carries the lenses, and the mirrors being arranged in polygons around the axis of rotation and attached to a fixed frame, produce a constant smaller light during the intervals between the flashes, and serve, at the same time, to prolong their duration.

"I need scarcely inform the committee that the flash of the lens in this new apparatus is far superior, both in brilliancy and size, to that produced by the reflector on each face of the old apparatus, as many of the members, and particularly the convener, on several occasions witnessed the effects of the contrasted lights. But I cannot omit an observation made by Mr. Claude Russell, the accountant of the board, who, in the course of watching the two lights from the Dean's bridge, which is about six and a half miles distant from Inchkeith, saw the flash of the lens light recur several times without the reflected light being visible. This is a very important fact, and clearly shows that certain degrees of haze exist, which, though capable of obscuring a weaker light, may be penetrated by the flash of the lens. Another fact of some interest regarding the relative power of the lights, is their difference of color; and so great was this difference on some occasions during foggy weather, that some persons, who were not aware of the arrangements made for the trial, could scarcely be persuaded that the reflected light was not artificially colored, its reddish tinge, acquired by the absorbing effects of the fog, being strongly contrasted with the white and more intense light of the lens. That the new light is more powerful than that which has lately been discontinued is still farther proved by the fact that the relative maximum intensities of the two lights have been ascertained from repeated comparisons, before the exhibition of the light, by the method of shadows, and are represented by the numbers 400 and 1,000, in which unity expresses the effect of a single unassisted Argand flame,
three-fourths of an inch in diameter. It thus appears that the new dioptic light is about two and a half times more powerful than the cataoptric light."

---

Mr. Alan Stevenson, the indefatigable and distinguished engineer to the Scotch lights commissioners, says on page 4 of his report on the Isle of May light, October 8, 1836:

"The first opportunity I had of observing the reflected and refracted lights at the Isle of May, in contrast, was on the night of the 23d ultimo, at Crail, which is distant about six miles from the light-house. At this place the difference both in regard to the color and size of the two lights was very remarkable, and decidedly in favor of the dioptic light, which appeared considerably larger and whiter than its rival. In walking along the coast I reached a point where the penumbrae of the two conjoined reflectors came into view, and the gradual decay of the reflected light to its weakest state rendered the superiority of the new light, which maintained its brilliancy unabated, still more remarkable. Satisfactory as these results may appear, I have yet, my own observations and those of others, obtained still more unequivocal proofs of the peculiar fitness of the dioptic instruments in fixed lights. On the night of the 24th ultimo I visited Dunbar, which is about thirteen miles from the Isle of May, and observed the contrasted lights from that place in the company of two friends, who took much interest in the success of the experiment.

"The night was hazy, and before the hour appointed for illuminating the new apparatus no light could be discovered; but the time had no sooner arrived, than a strong and steady light broke into view, and continued during the prescribed period with unabated brightness, while the old light could only be observed during fleeting intervals of time, and even then was scarcely visible, and certainly could not have been discovered but by those acquainted with its position in relation to the new light. Immediately before the extinction of the dioptic light, I carefully took the bearing of the old light, so as to be able afterwards to find its exact locality; and when the new light was extinguished, I found that, even with the assistance of the bearing, I had the greatest difficulty in ascertaining by actual vision the existence of a light at all. In these remarks the friends who accompanied me fully concurred; and one of them, who had an opportunity of repeating these observations at Dunbar, on the night of the 30th ultimo, detailed the result in a letter to me, from which I beg leave to make an extract, fully corroborative of what I have stated above. After alluding to the state of the atmosphere, which was very foggy over the sea, he says: 'I went to the pier-head, where, to my great satisfaction, I at once discovered the light. It was much redder than when we saw it last Saturday night, owing, I have no doubt, to the density of the fog; but still it was perfectly visible. Having thus ascertained the exact position of the light, I once more attempted to catch the old one; but though I once or twice thought I discovered something like a star looming in the distance, I am not prepared to aver
that I saw it. I would therefore say, that my last night’s observation fully justified the conclusion arrived at on Saturday night.

"Since these observations were made at Dunbar, the engineer of the board has tried, during five successive nights, several interesting experiments on the lights at the Isle of May, the effect of which he witnessed at various distances on the coast of Fifeshire, and from the deck of the lighthouse tender. The first object of these experiments was to try the effect of the curved mirrors alone; and for this purpose the light-keeper was instructed to have the cylindric hoop of refactorors wrapped around with two folds of thick woollen blankets, a single fold having been found insufficient to prevent a large quantity of light from being transmitted. The tender having put to sea, the unassisted light of the prisms and the old catoptric light were seen in contrast, at various distances from five to twelve miles, and it appeared to be the opinion of all on board that, although the reflectors gave a much more powerful light on one tack, the curved mirrors had the advantage on the other tack, according as the axis or penumbrae of the parabolic instruments came in the line of vision. At the distance of twelve miles the curved mirrors appeared like a reflector light of an inferior description—a result quite accordant with the value of a hundred and thirty Argand flames, which has been determined as the mean effect of the system of mirrors. At the lapse of the time mentioned in the instructions given to the light-keeper, the refactorors were uncovered, and the instantaneous accession of the strong light had a striking effect, which the master of the tender compared to a sudden flash of lightning. The two lights were then seen in their full power, and the greater whiteness and purity of the refracted light was distinguishable, even where the full effect of a reflector was presented to the eye. The deficiency at the junction of two reflectors rendered this difference much more remarkable; and in his letter to me, the engineer says: ‘In sailing around, I find the old light is subject to interstitial defects, and that the refractor is in this respect a great improvement.’*

The curved mirrors were then screened, so as to exhibit only the refracting part of the new apparatus along with the reflectors, and the only change which took place was a small decrease in the volume of the new light, which still retained its greater intensity.

"These observations are strikingly conclusive as to the superiority of the refracted light, the whiteness and purity of which indicate its greater intensity, and justify the accuracy of the numerical value assigned to these lights in a subsequent part of this report. It is not to be expected that a distant observer can detect the proportions of intensity, which can only be measured by means of a definite standard; and a difference of color is all the indication of a stronger light, which ought to be looked for in observations made under such circumstances.

"The important results which I have just detailed leave no room for any further remarks on the superiority of the dioptric instruments to reflectors in fixed lights; and I should scarcely be excusable for saying

---

* This deficiency would have been somewhat less remarkable had there been (as in all the other fixed lights) twenty-four small reflectors instead of twenty-two large ones; but the defect of light at the junction of two reflectors is always too remarkable in any arrangement.
more upon the subject were it not to add, that while the mean intensity of the light has been increased to considerably more than twice that of the old one, a positive saving has been effected in the expenditure of oil, in the ratio of 17 to 24. Besides, the new light is now entirely free from the defect which is inherent in every fixed light on the catoptric principle—that of being _unequally powerful_ in different directions, according as the axis or the edge of the reflector may be presented to the eye of the observer. The conversion of the fixed lights to the dioptic system would thus appear to be in a measure worthy of general adoption; and there are certain situations where this change would be more especially advantageous, as, for instance, in the case of double lights, in which the equal distribution of light becomes of great importance, in rendering them equally brilliant at the same distance. The saving which might thereby be effected in the expenditure of oil would also be considerable at double lights; and at the almost inaccessible station of Pentland Skerries, for example, the quantity of oil to be landed would be reduced from fifty to thirty-four casks.”

---

**Comparative view of the expenditure of oil in the undermentioned lights, on the coast of Scotland, if continued on the reflecting or altered to the refracting system:**

<table>
<thead>
<tr>
<th>Location</th>
<th>Reflecting</th>
<th>Refracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinnaird Head</td>
<td>752 gallons</td>
<td>560 gallons</td>
</tr>
<tr>
<td>Tarbetness</td>
<td>887</td>
<td>560</td>
</tr>
<tr>
<td>Pentland Skerries</td>
<td>1,726</td>
<td>1,120</td>
</tr>
<tr>
<td>Sumburgh Head</td>
<td>1,060</td>
<td>560</td>
</tr>
<tr>
<td>Dunnet Head</td>
<td>764</td>
<td>560</td>
</tr>
<tr>
<td>Island Glass</td>
<td>776</td>
<td>560</td>
</tr>
<tr>
<td>Barra Head</td>
<td>1,099</td>
<td>560</td>
</tr>
<tr>
<td>Lismore</td>
<td>741</td>
<td>400</td>
</tr>
</tbody>
</table>

---

**THIRTY-SEVENTH CONGRESS—SECOND SESSION.**

**IN SENATE.**

**Monday, March 31, 1862.**

**LIGHT-HOUSE INSPECTORS.**

Mr. Chandler. I now move to take up House bill No. 243, providing for the appointment of light-house inspectors.

The motion was agreed to; and the Senate, as in Committee of the Whole, resumed the consideration of the bill. The Committee on Commerce reported an amendment to the bill to strike out all of it after the enacting clause and insert the following in lieu thereof:

“That so much of the act entitled ‘an act making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and
establishment of the same, and for other purposes," approved August 31, 1852, be, and hereby is, so far modified as to authorize the President to direct the detail of officers of the revenue-cutter service to serve as light-house inspectors in any of the light-house districts created by the said act: Provided, That officers of the revenue-cutter service so detailed shall not be entitled to any increase of compensation for such service."

Mr. Grimes moved to amend the amendment of the committee by adding as an additional section:

"And be it further enacted, That all acts and parts of acts authorizing or requiring the detail of officers of the Army or Navy for service as inspectors, or for the performance of other duty in connection with the light-houses of the United States, be, and the same are hereby, repealed."

The President pro tempore. The question is on the amendment of the Senator from Iowa to the amendment reported by the committee.

Mr. Chandler. I hope that amendment will not prevail. I shall make no remarks upon it.

Mr. Grimes. Mr. President, fortunately for the people of the section in which I reside, we have no necessity for these artificial lights. I believe it is a necessity that exists only in certain sections of the country, and where it is believed that the people of those sections should have the exclusive control of them; and in order to carry that idea out more perfectly, I shall withdraw my amendment, and allow the Senator from Michigan to perfect his bill to suit himself.

The President pro tempore. The amendment to the amendment being withdrawn, the question recurs on the amendment reported by the Committee on Commerce.

Mr. Fessenden. I very much prefer the amendment of the Committee on Commerce to the original bill, because it relieves the bill from the great difficulty of making the matter political entirely so far as regards the appointment of these officers. Notwithstanding what has been said by the honorable chairman of the Committee on Commerce with reference to the views of the Secretary of the Treasury, I am yet of the opinion that it is unwise to make the proposed change. I have very great confidence in the management of the Light-House Board; I have read the reports carefully, and I am perfectly cognizant of the very great improvements in all particulars with reference to light-houses that have taken place in the last ten years under the management of that board. It is unquestionably true that from having a very bad system, they have brought it to be one of the very best, if not the best, in the world, making the greatest improvements in all particulars as to lights, oil, and everything connected with light-houses; and at the same time they have diminished the cost comparatively. The number of lights has been increased from necessity; but the cost per light, when you come to examine the average, has been reduced, I think, something like $180. The system has been recognized as a most admirable one, not only in our own country but by foreigners. From a very bad one, it has been brought by the board to as good a system probably as it can very well be made.

The organization of the board is such as necessarily to bring about
that result. The Secretary of the Treasury is at the head of it and nominally the president of the board; but the business is done by the board itself, consisting of officers of the Navy, of officers of the engineer corps, and of scientific men who attend to the matters of detail and matters of improvement. This is the simple state of the case. Officers of the engineer corps, for instance, are employed in erecting the buildings, in which there has been very great improvement. Substantial, although comparatively cheap, buildings have been erected wherever needed, to a very great extent. Officers of the Navy are employed in examinations, and in various matters connected with the business. One of the members of the board is the Superintendent of the Coast Survey, whose knowledge of the coast furnishes him with information as to proper places where light-houses should be erected. And the whole board together, consisting of men of character and eminence, act upon the contracts and the expenditure of money; and the money has been expended without any complaint from anybody, with very great ability and very great carefulness.

Now, sir, I do not see the necessity of interfering with the arrangement which has worked so well; and it is the opinion of the board itself that any interference with it will be likely to produce injury rather than good. I have very much greater confidence in the opinion of those men who have been managing it for ten years and under whom it has arrived to its present state of perfection, than I have in the opinion of the Secretary of the Treasury, who although president of the board is merely nominally so, and has not, as he informed me, personally taken pains to study the question at all, and to inform himself upon it, because he has not had the time to do so; and, therefore, whatever may be my respect for him and his opinion on a matter that he has investigated, I think it ought not to outweigh the opinion of men who have for years been devoted to the business itself.

Under these circumstances, I do not believe in the good sense of interfering with the system and appointing revenue officers inspectors of light-houses. It is said they can attend to the duties. They can attend to a certain part of the duties perhaps. The system perhaps might be changed to that extent; I do not know how that is, but to allow the revenue vessels to visit the different light-house establishments, and to make their commanders superintendents, (which involves the whole management on shore of everything connected with the system, and looking over the districts, and the light-house districts are more extensive than the revenue districts,) I think is incompatible with the duties they have to perform. Besides they are under different direction; they are under the direction of the collectors of the different ports; they must go where they are sent and attend to the business which is peculiar to themselves, and the number is very limited comparatively. I do not believe they can possibly have the time to attend to this business in addition to their own.

Again, sir, I do not think that the revenue officers are generally men of sufficient education to fill the office of superintendent of light-houses. They are now filled by officers of the Army or Navy, ordinarily men of scientific attainments, and who are capable themselves of regulating
the affairs of the light-house district. The revenue officers as a general rule—there may be some exceptions among them—are not of that class of men. They are smart men in their way; some of them are perhaps fit for these places; but ordinarily, they are not men of the knowledge requisite to oversee such extensive establishments and become acquainted with all the questions necessarily involved in the superintendency of a light-house district. I do not know but that a little money could be saved by the change, though I do not see how. It may be that a little money may be saved on the travel, but that can be regulated very easily. The pay of military or naval officers is not increased when in this service; they have the same pay precisely that they have as officers of their proper grades; and it will be so with the revenue officers.

I believe, therefore, on the whole, I have no hesitation in expressing my own opinion, that the movement of the Secretary to interfere with this system by putting into it the revenue service will be attended with injury; that it is safer, very much safer, when you have a system that has worked admirably and produced good results, to leave it where it is, rather than to interfere with it by infusing into it a new element. It is of course for the Senate to do what is sees fit on the subject. My own opinions are fixed.

Mr. Chandler. I concur entirely with the Senator from Maine in his high encomiums on the present organization and conduct of the light-house system. This proposition is a very simple one. It does not interfere in the slightest degree with the present organization, except to this extent; as is well-known to every member of Congress, and to almost every man in the country, we have a greater demand for officers both in the Army and Navy than we have a supply at the present time; and this bill simply authorizes the Secretary of the Treasury to select, at his discretion, officers of the revenue service for this duty who are necessarily compelled to be upon their stations at this time. If there are incompetent officers of the revenue service, as there undoubtedly are, the Secretary of the Treasury would certainly be the last person to select such men to fill these positions. Upon the lakes this spring we require these officers to act as superintendents of lights. The light-houses must be supplied; they must be inspected. They must prepare for lighting our lakes immediately, and we have no officers of the Army or Navy to detail to that service. It will be a matter of economy for this reason: officers of the Army and Navy, as Senators well know, while waiting orders are on small pay comparatively; but when in active service they draw a very largely-increased pay. If a man is incompetent for active service at this time in any capacity in the Army or Navy, he is certainly incompetent to superintend our lights, and I object to a man who is so utterly incompetent as to be incapable of even recruiting or mustering soldiers into service at this time being detailed to this duty. I had a conversation no longer ago than Saturday with the Secretary of the Treasury, and he told me that he deemed it of very great importance that this bill should pass, and pass now; that the service required it, and I believe it. If the talent, if the materiel in the revenue service is so low, as the Senator would seem to intimate, that it is not competent to superintend light-houses, I think it should be
raised. As I said the other day, it is being raised. We increased the pay of these officers fifty per cent. last summer, and as I am informed by the Secretary and Assistant Secretary of the Treasury, they are getting a higher grade of talent in the revenue service than they have been heretofore able to obtain at the former compensation. At any rate, I think it is no more than an act of justice to the Secretary to let him make the trial in this his time of need and necessity. I hope the amendment will prevail. I believe it is important.

Mr. Fessenden. There must be some very great mistake about this. Everybody knows that the executive officer of the Light-house Board is a man of the very highest capacity in his line, and he has been the executive officer most of the time for the last ten years. I allude to Commander Jenkins, of the Navy. He is the man who, under the direction of the board, has managed the whole business. I conversed with Commander Jenkins, and he knows more about the system, its wants, its necessities, everything in connection with it, than forty Secretaries of the Treasury, situated as Mr. Chase is, and I say it with all respect to him.

The Senator tells us that the Secretary of the Treasury says he is in great need of this change. He has nothing to do with the Light-house Board at all except to preside, if he chooses to attend the meetings. He does not know to-day the condition of it, or comparatively anything about it, if I may trust to his own word. Mr. Jenkins told me not three days ago—for I went up to consult him—that there was not the slightest need of interfering with it in any way whatever, for the simple reason that, notwithstanding the engagements of the officers of the Army and Navy at the present time, everything went on perfectly well without them, under the direction of the board with the engineers in charge, as they are called. There is an engineer—a civil engineer—employed in every district. In the district which comprehends the line of coast where I live, the engineer, a gentleman with whom I am acquainted, is a man of the highest capacity; he manages the whole thing under the board, and there is no need of a revenue officer or any other officer there. Mr. Jenkins says there is no need of them anywhere at present. The business of the light-house concern goes on perfectly well, without the slightest difficulty arising from the engagements of the officers of the Army and Navy at the present time. Suppose you wanted one who was an officer in absolute active service, it is a perfect non sequitur that, because he is not fit to go to sea, therefore he cannot in an office manage a light-house district, with the engineers and the captains of light-vessels and all the machinery which is connected with it. It is a mistake to suppose any such thing, and if Mr. Chase, the Secretary of the Treasury, has such an idea, I undertake to say he must be laboring under some strange delusion. He does not pretend to know anything of the light-house system. What he may want to make with his new revenue fleet that he is building up, and what power he may want to give to them, I do not know; but it is not connected with the Light-house Board; it is connected with the revenue fleet. That is the amount of it; and that, unquestionably, he knows all about; but the difficulty is the interference with the light-house system; it is that I object.
How is it now? All these officers are detailed by the board, the whole board, acting as a board, not by the Secretary of the Treasury. He is not the all in all in the light-house establishment. It is under the control of a board of men, and men of the highest character. General Totten is a member, Professor Bache is a member, Professor Henry is one, and there are several other gentlemen, officers of the Army and Navy—Captain Humphries, Mr. Jenkins himself, and others. They detail these men. They apply to the War Department or the Navy Department for an officer of a particular kind, and they detail him and send him out. The Secretary of the Treasury does not do it. Now, what does this bill propose? It proposes that the Secretary of the Treasury shall not only retain his power as president of the board, to act with the others in relation to the light-house establishment as it has been going on for ten years, but to give him the absolute power of interference; to take men out of his own revenue fleet and put them upon the board at his discretion. It is breaking up the system.

Now, sir, with all my respect—and no man entertains more—and all my personal regard for the Secretary of the Treasury, I think the whole thing would be excessively injurious to an interest in which I feel a very deep concern, and that is the interest of light-houses on our coast. We know that a great many light-houses and lights have been broken up and destroyed on the southern coast. They are soon to be rebuilt, and soon to be relighted. To put this matter in the hands of the revenue officers who have business enough of their own, in the first place, in my judgment, if carried out, will require a very vast increase of the revenue force in order to attend to it. It is bad, I think, in every aspect; and notwithstanding all that has been or can be said, I must remain of that opinion. I hope the bill will not pass. When you have a system that in an experience of ten years has been found to work admirably, to the satisfaction of everybody, both with regard to its cheapness and the perfection of its operations, I believe it is unsafe, on the recommendation of any Secretary of the Treasury or anybody else, to break into it by measures of this description.

Mr. King. This bill had passed the House of Representatives and was referred to the Committee on Commerce of the Senate, when the committee took it up. Without having sufficient information themselves to determine on the propriety of it, it was referred by the committee to the Treasury Department for information. The clerk took it up, and then the chairman himself went and consulted the Secretary of the Treasury. On a very full interview with him, the information communicated to us in relation to the character of these officers and the economy of the service, which was one of the points considered by the committee, the committee were satisfied that the recommendations of the Secretary of the Treasury were entitled to respect, and unanimously assented to the bill as it has been reported. This is the condition of it.

Mr. McDougall: I have been informed that the Secretary of the Treasury has recently, upon a more careful examination of this subject and fuller consideration, changed his mind on this subject, and prefers now that the light-house system should remain as it is.

Mr. Chandler. Permit me to say to the Senator from California that
I had an interview with the Secretary on Saturday, and that no such change had taken place then. If it has taken place, it has occurred since.

Mr. McDougall. I do not propose to argue the question; but, as the Senator from Maine has said, this board has now been organized for a number of years; it has led to great results, to a perfect system. As I understand, the members of the board receive no compensation for their services as such.

Mr. Fessenden. None at all.

Mr. McDougall. They embrace men of various descriptions of science. They have divided off the various departments of their business, organized into committees those who have charge of the location of lights, the construction of light-houses, the lights themselves, and experiments in lights. They have been carrying on a series of experiments that have greatly advanced the service, and made it far more economical. It is now admitted to be a perfect system; and a change such as is indicated would be an abandonment of the system. Why should the change be made? An officer of the revenue service is selected for his skill in navigation simply handling his ship, being a reliable and intelligent gentleman, and a good sailor. Now, however, we select for this kind of service persons who have studied the specialties belonging to it. There is no question about the system having been economically administered. It has accomplished great results. I think it would be a public misfortune to abandon it at the instance of no matter how high an officer of the Government, who is not master of this particular subject. The Secretary of the Treasury lives in the interior; he has had very little to do with the business of light-houses, probably has never studied any one of its specialties, and he comes into the Department now and makes his suggestions. He may see some causes why he would prefer this change; but I think it would be a great misfortune to abandon a successful organization and make a change at the instance of an officer of the Government who certainly is not familiar with the particular subject.

Mr. Chandler. The Senator from California says that these officers receive no increase of pay. He is mistaken about that.

Mr. McDougall. I spoke of the board.

Mr. Chandler. The officers who are put on this duty are on leave of absence, and the Senator knows very well that when an officer of the Army or Navy is on active duty he receives a great deal more pay than when he is on leave of absence; and they get a much larger salary than we pay to the revenue officers. They have quarters; they receive mileage; they receive the difference between leave-of-absence pay and active-service pay, all of which swells the expense of the system. This bill will effect a saving of many thousands of dollars to the Treasury, and will, in my estimation, actually improve the service. The officers of the revenue cutters are continually moving about in their revenue districts. The Senator from Maine is mistaken in supposing they are busily employed in watching the revenue. As I am informed by the Secretary of the Treasury, they have ample time for this service, and it is provided that they shall have no increase of pay for attending to it;
they will simply continue to receive the pay to which they are entitled as captains or lieutenants of the revenue service as the case may be. Upon the lakes at this time I know it would save many thousands of dollars, and actually improve the service. The same engineers that have heretofore been superintending the building of light-houses will continue. Civilians have heretofore been employed in many cases; most of our light houses have been built by civil engineers, employed by the superintendent of lights to build them. I think the Committee on Commerce spent at least two months in a thorough examination of this subject, and they unanimously came to the conclusion that it would be beneficial to the service, economical to the Treasury, and better in every respect that this bill should pass.

Mr. Grimes. If the committee have spent that length of time on this subject, they can probably give the Senate some information that would be desirable before we proceed to vote upon it; and I should like to know how many more officers will be required to be appointed into the revenue service, if we adopt this bill, than are now appointed.

Mr. Chandler. I can answer that at once. Not one.

Mr. Grimes. Then I should like to know how they are going to do the business when the light-house districts do not at all correspond with the revenue districts. There are only twelve light-house districts. One of them is on the California coast, for instance. There are several revenue districts. Now, how is the revenue officer on the California coast going to perform all his duties on that entire coast, and yet attend to all the duties in connection with the light-houses? I think the committee have not got very accurate information on that subject.

Mr. Chandler. Very.

Mr. Grimes. Then I should like to have the Senator explain it.

Mr. Chandler. Does the Senator desire an answer now?

Mr. Fessenden. I should like to ask one question of the chairman, and that is whether he or the Committee on Commerce has ever consulted with the Light-house Board on this subject?

Mr. Chandler. We had their report before us, the same as the Senator had.

Mr. Fessenden. That is on another subject; but have you ever consulted them on this point, as to giving this service to the revenue officers?

Mr. Chandler. No; we did not deem it necessary.

Mr. Grimes. The Senator spoke about the present inspectors drawing mileage. Does he mean to say that the officers of the Navy who are on the inspecting vessels—the light-house vessels—have been drawing mileage?

Mr. Chandler. If they take a Government vessel, they do not draw mileage; but if they do not, they travel, and are paid for it.

Mr. Grimes. Then, does the Senator suppose that the revenue officer, when he is not on a revenue vessel, is not going to draw mileage?

Mr. Chandler. The revenue officer goes with his vessel.

Mr. Grimes. Exactly; and so does—

Mr. Chandler. Pardon me. The Army or Navy officer has not a vessel, and cannot get one belonging to the Government.
Mr. Grimes. That is where the Senator is mistaken. The committee have not thoroughly investigated the subject.

Mr. Chandler. Yes, we have.

Mr. Grimes. The Senator will pardon me—

Mr. Fessenden. We have two of these vessels in my town.

Mr. Grimes. The Senator from Michigan has not thoroughly examined that subject, nor has his committee. There is a vessel put in charge of each one of these inspectors. The Senate will remember, doubtless, that some of these very vessels were captured by the rebels, one at Charleston a year ago this spring, one at the mouth of the Mississippi river, one in Texas, and one in the waters of North Carolina. The Senator from Maine says that there are two of them to-day in the harbor of Portland. As the board is at present organized, the inspectors draw no mileage when they are on these vessels; nor will the revenue officers when they are on the revenue vessels; but when you transfer them from the revenue vessels, and make them pay their own expenses, the revenue officers, as well as the Navy officers, will draw mileage, so that the Senator is altogether mistaken, I apprehend, on that subject. I do not see any purpose in this bill except to create, first, a new batch of officers, and second, to make the place of light-house inspector a political office rather than a profession. If that is the purpose, we had better pass the bill, not otherwise.

Mr. Chandler. The Senator from Iowa is making a very large mountain of a very small mole hill. There is nothing compulsory about this at all. There is no change forced upon the Secretary of the Treasury or upon the Light-house Board. Here is a simple proposition permitting the Secretary of the Treasury, in case the exigencies of the service require it, to appoint a captain of a revenue cutter to perform this duty. If it is more economical or better that an officer of the Army or Navy should be appointed in any district, he will be appointed. If there is any case where it is better, where it is for the interest of the Treasury, to appoint a revenue officer, he will be appointed. Perhaps two, or three, or half a dozen revenue officers, perhaps not any, will be appointed under this bill. It simply gives the power to the Secretary of the Treasury to select one of his own officers to perform a duty which is in his hands, and ought to be there. It is not the Army or the Navy, it is the mercantile marine that is benefited by the light-house system. Of course it is for the interest of the Secretary of the Treasury to keep up this service to the highest standard at which he can keep it. I hope the amendment of the committee will prevail. I ask for the yeas and nays upon it.

The yeas and nays were ordered.

Mr. Clark. I did not propose to interfere in this debate; but the proceeding of the Committee on Commerce strikes me so singularly that I cannot forbear to say a word or two in opposition to this amendment. We have confessedly had a Light-house Board now for some eight or ten years that have managed the system of the light-houses and the lights admirably well; I think no fault is found with them anywhere; and now, not upon the suggestion of that board, nor upon any requirement of the
service by those who have charge of it, but from outside influence, it is proposed to interfere with that board, and take from them the control of it in the manner in which they have had it heretofore. I understand the chairman of the Committee of Commerce to say that this allows the Secretary of the Treasury to appoint. I do not so understand his bill. The bill says the President shall detail.

Mr. Chandler. Certainly.

Mr. Clark. Suppose, then, the President of the United States undertakes to interfere with the Light-house Board, or the movements of the Treasury Department, and appoint these officers wherever he chooses; the least you will have will be an interference of one service with another; and it seems to me it will be a great deal better to leave this service precisely where it is now, and where it has worked so well. If you let it go on as it is, you know that it will work well, because it has worked well for the last eight or ten years. If you interfere with it, you do not know that it will work well, because you are trying an experiment. Now, I hold it is better in legislation, as in other things, to "let well enough alone," and if you find your lights well cared for, your harbors well lighted, your commerce well protected in that particular, it is better to let the thing stand as it is.

Mr. Chandler. Mr. President, here is an emergency; your Army and your Navy require every man you have got, and more, immediately, in the field and on the water; and now we ask what? Simply that the men who are placed as the guardians of commerce, commanders of your revenue cutters, shall have the privilege of inspecting your lights. Senators say it is well enough as it is. It has been well enough because you have had one hundred and fifty or two hundred officers of the Army and Navy with nothing on God's earth to do. Now, you have none, and we simply come in and ask that the Secretary of the Treasury—I say the Secretary of the Treasury because the President always fixes such appointments in accordance with the requests of the heads of Departments—shall have the privilege, during this emergency, of selecting his own revenue officers, appointed by himself or by the President, to do labor which you have nobody else to do; and Senators now get up and say let well enough alone. It is not well enough; you have got nobody to do the work now.

Mr. Clark. One answer to the Senator from Michigan, the chairman of the Committee on Commerce, is, that his bill does not provide for any emergency. Who has told us anything about this emergency? Has the President of the United States said that he has not got Army officers or Navy officers for this service? Has the Secretary of War said "I cannot spare an Army officer on this service?" Has the Secretary of the Navy said "I cannot spare a naval officer?" No, sir; but the Secretary of the Treasury says "I can spare you a revenue officer." Now, without the President saying a word about it, without the Secretary of War saying a word about it, without the Secretary of the Navy saying there is any scarcity of men to perform this service, the Secretary of the Treasury wants to put his men in the service. That is where the emergency comes from.

Mr. Chandler. Permit me to ask the Senator, does he not know
himself that there are not officers enough for the Army and the Navy? Is it not apparent to every member of this body, and to every man in this nation, that you have no Army or Navy officers to spare? You are appointing them here by dozens and hundreds almost every day.

Mr. Clark. I do not understand that there is any fault about the officers of the Army or the Navy that they are not numerous enough. That is not the trouble. If there is any trouble, it is that there is not quite fight enough in them. I do not believe they will fight any better, if you put revenue officers upon light-house duty. That will not cure them. If these men are not put to fight, let them manage the lights, let them be doing something. The difficulty is not there; the difficulty is in the want of the animus. You have got men enough to lead your armies anywhere, and to carry your ships anywhere. You will not help it by putting revenue officers on light-house service. Does the Senator expect that Army or Navy officers will fight better because you put revenue officers on this board? Has he heard that this board wanted or suggested any medicine of that kind? I think the Senator would not agree to that. I think he knows as well as I know that the cause lies deeper, and that he may cover the Light-House Board all over with revenue officers, he may put a revenue officer as inspector in every sea and every harbor, and it will not make your armies fight. That is not the light they want; they want a little of the light of courage and zeal.

Mr. Chandler. I agree with you there.

Mr. Clark. Very well; take the proper remedy.

Mr. Ten Eyck. We have have heard a great deal during the present session about extravagance in the expenditure of the public money, extravagance everywhere, nay, something more than extravagance, until it has been said that this nation is becoming so involved in debt that it will not be relieved from the consequences for many generations. Now as this bill was originally proposed, it was designed to make this change only during the existing rebellion. The Committee on Commerce, having heard and realized the fact that there was vast extravagance and vast expenditure, thought it desirable, highly important, that a change should be made in this system by which thousands of dollars might be saved annually to the Government, provided the service could be performed as well. That was the great leading feature of this movement, and when we strip it of all these collateral matters about fighting, who is ready to fight and who is not, and bring the question back again to the true point in issue, it strikes me that there is merit in this bill. I do not know that the committee have considered the subject two months continuously; I frankly admit for myself that I have not critically examined it; and perhaps if I had, I should not understand all its minute particulars; but the great, prominent, striking fact was that we desired to have this service performed, as well, we believed, as it is now being performed, at a vast saving of public expenditure. That was the idea of the Secretary of the Treasury, and that was the idea of the committee, and it strikes me that, under existing circumstances, the idea was a correct one. The amendment proposed by the committee changes the character of the bill from a temporary one to a permanent one; but if it shall be found hereafter, after the rebellion is over, that there has been
a mistake in this change, Congress will have nothing to do but to restore the system back to its original state, and there will be no difficulty growing out of our legislation upon the subject. My object simply was to recall the attention of the Senate to the point involved in the bill and to strip it, if I could, from extraneous influences.

Mr. Morrill. As this bill has given rise to a debate which seems likely to continue, and as the bill abolishing slavery in the District of Columbia was put aside the other day to give place to the naval appropriation bill, I appeal to my friend from Michigan to allow this bill to subside and let the Senate proceed with the consideration of that bill.

Mr. Chandler. If this bill leads to any further debate, I certainly shall not press it now; but I think the debate is ended; I believe we are ready to vote.

Mr. Morrill. If the Senator will allow it to go over I think it will be better. It deserves further consideration.

Mr. Chandler. Very well.

Mr. Morrill. I move to lay aside this bill and take up Senate bill No. 108.

The motion was agreed to.

AN ACT making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.—(Statutes at Large, vol. 10, pp. 119, 120, and 121.)

*  *  *  *  *  *

· SEC. 8. And be it further enacted, That the President be, and he is hereby, authorized and required to appoint, immediately after the passage of this act, two officers of the Navy of high rank, one officer of the corps of engineers of the Army, one officer of the corps of topographical engineers of the Army, and two civilians of high scientific attainments, whose services may be at the disposal of the President, and an officer of the Navy and an officer of engineers of the Army as secretaries, who shall constitute the Light-house Board of the United States, and shall have power to adopt such rules and regulations for the government of their meetings as they may judge expedient; and the board so constituted shall be attached to the office of the Secretary of the Treasury, and, under his superintendence, shall discharge all the administrative duties of said office relating to the construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, sea-marks, and their appendages, and embracing the security of foundations of works already existing, procuring illuminating and other apparatus, supplies, and materials of all kinds for building, and for rebuilding when necessary, and keeping in good repair the light-houses, light-vessels, beacons, and buoys of the United States.

Sec. 9. And be it further enacted, That the Secretary of the Treasury shall be ex-officio president of the Light-house Board of the United States; and the said board at their first meeting shall proceed to ballot for one of their members as chairman, and the member who shall receive the majority of ballots of the whole board shall be declared by the presi-
dent to be chairman of the Light-house Board, who shall, in the absence of the president of the board, preside over their meetings, and do and perform such acts as may be required by the rules of the board.

SEC. 10. And be it further enacted, That the Light-house Board shall meet four times in each year for the transaction of general and special business, each meeting to commence on the first Monday in March, June, September, and December; and that the Secretary of the Treasury is hereby authorized to convene the Light-house Board whenever, in his judgment, the exigencies of the service may require it.

SEC. 11. And be it further enacted, That the Secretary of the Treasury be, and he is hereby, required to cause such clerks as are now employed on light-house duties in the Treasury Department to be transferred to the Light-house Board without any change of salary, and to provide the necessary accommodations for the secretaries and clerks, for the preservation of the archives, models, drawings, &c., and for holding the meetings of the board; and that he cause to be transferred to the proper officers of the Light-house Board all the archives, books, documents, drawings, models, returns, apparatus, &c., belonging to the Light-house Establishment of the United States.

SEC. 12. And be it further enacted, That it shall be the duty of the Light-house Board, immediately after being organized, to arrange the Atlantic, Gulf, Pacific, and lake coasts of the United States into light-house districts, not exceeding twelve in number; and the President is hereby authorized and required to direct that an officer of the army or navy may be assigned to each district as a light-house inspector, subject to and under the orders of the Light-House Board, who shall receive for such service the pay and emoluments that he would be entitled to by law for the performance of duty in the regular line of his profession, and no other, except the legal allowance per mile when travelling under orders connected with his duties.

SEC. 13. And be it further enacted, That the said Light-house Board, by and with the consent and approbation of the Secretary of the Treasury, be authorized and required to cause to be prepared and distributed among the light-keepers, inspectors, and others employed in the light-house establishment, such rules, regulations, and instructions as shall be necessary for securing an efficient, uniform, and economical system of administering the light-house establishment of the United States, and to secure responsibility from them; which rules, regulations, and instructions, when approved, shall be respected and obeyed until altered and annulled by the same authority.

SEC. 14. And be it further enacted, That it shall be the duty of the Light-house Board to cause to be prepared, by the engineer secretary of the board, or by such officer of engineers of the army as may be detailed for that service, all plans, drawings, specifications, and estimates of cost of all illuminating and other apparatus, and of construction and of repair of towers, buildings, &c., connected with the light-house establishment; and no bid or contract shall be accepted or entered into except upon the decision of the board, at a regular or special meeting, and through their properly authorized officers.

SEC. 15. And be it further enacted, That hereafter all materials for
the construction and repair of light-houses, light-vessels, beacons, buoys, &c., &c., shall be procured by public contracts, under such regulations as the board may, from time to time, adopt, subject to the approval of the Secretary of the Treasury; and all works of construction, renovation, and repair shall be made by the orders of the board, under the immediate superintendence of their engineer secretary, or of such engineer of the army as may be detailed for that purpose.

Sec. 16. And be it further enacted, That it shall be the duty of the Light-house Board to furnish, upon the requisition of the Secretary of the Treasury, all the estimates of expense which the several branches of the light-house service may require, and such other information as may be required to be laid before Congress at the commencement of each session.

Sec. 17. And be it further enacted, That all acts and parts of acts inconsistent with the provisions of this act are hereby repealed, and all acts and parts of acts relating to the light-house establishment of the United States, not inconsistent with the provision of this act, and necessary to enable the Light-house Board, under the superintendence of the Secretary of the Treasury, to perform all duties relating to the management, construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, sea-marks, and their accessories, including the procuring and testing of apparatus, supplies, and materials of all kinds for illuminating, building, and rebuilding when necessary, maintaining and keeping in good repair the light-houses, light-vessels, beacons, buoys, and sea-marks of the United States, and the second and third sections of the act making appropriations for light-houses, light-vessels, buoys, &c., approved March third, eighteen hundred and fifty-one, are hereby declared to be in full force, and shall have the same effect as though this act had not passed: Provided, That no additional salary shall be allowed to any civil, military, or naval officer who shall be employed on the Light-house Board, or who may be in any manner attached to the light-house service of the United States under this act: And provided, further, That it shall not be lawful for any member of the Light-house Board, inspector, light-keeper, or other person in any manner connected with the light-house service, to be engaged, either directly or indirectly, in any contract for labor, materials, or supplies for the light-house service, nor to possess, either as principal or agent, any pecuniary interest in any patent, plan, or mode of construction or illumination, or any article of supply for the light-house service of the United States.

Approved August 31, 1852.
ORGANIZATION OF THE UNITED STATES LIGHT-HOUSE BOARD, OCTOBER 9, 1852, UNDER THE AUTHORITY OF THE ACT OF CONGRESS APPROVED AUGUST 31, 1852.

PRESIDENT:

Hon. Thomas Corwin, Secretary of the Treasury, ex-officio President.

MEMBERS:

Commodore Wm. B. Shubrick, United States Navy.
Brevet Brigadier General Joseph G. Totten, United States Corps of Engineers.
Commander S. F. Du Pont, United States Navy.
Lieutenant Colonel James Kearney, United States Corps of Topographical Engineers.
Professor Alexander Dallas Bache, LL. D., &c., Superintendent United States Coast Survey.
Professor Joseph Henry, LL. D., &c., Secretary of the Smithsonian Institution.
Lieutenant Thornton A. Jenkins, United States Navy, Naval Secretary.
Captain Edmund L. F. Hardcastle, United States Corps of Topographical Engineers, Engineer Secretary.

OFFICE LIGHT-HOUSE BOARD,
Washington City, October 9, 1852.

The Hon. Thomas Corwin, Secretary of the Treasury and President ex-officio of the Light-house Board, called the Light-house Board to order at 12 M. Present all the members of the board, consisting of Captain Wm. Branford Shubrick, United States Navy; Commander S. F. Du Pont, United States Navy; General Jos. G. Totten, Corps of Engineers; Lieutenant Colonel James Kearney, Corps of Topographical Engineers; Professor Alex. D. Bache; Professor Joseph Henry; Lieutenant Thornton A. Jenkins, United States Navy; and Captain Edm'd L. F. Hardcastle, Corps of Topographical Engineers.

The President of the board stated that the first business of the board in order was to ballot for one of their members as Chairman, who shall, in the absence of the President of the Board, preside over their meetings and perform such acts as may be required by the rules of the board.

The members of the board then proceeded to ballot, and a majority of the ballots having been cast for Captain Wm. B. Shubrick, United States Navy, he was declared by the President to be elected the Chairman of the Light-house Board.

On motion of General Totten, it was then resolved that Captain Wm. B. Shubrick, United States Navy, be the Chairman by the unanimous vote of the members of the board.

The following resolutions were then unanimously adopted:

Resolved, That General Totten, Professor Bache, and Professor Henry
be appointed a committee to draw up a plan for the conduct of the business of the board, and rules and regulations for its government.

Carried unanimously.

At the request of General Totten, he was temporarily excused from serving on this committee, and Commodore Shubrick was substituted in his stead.

Resolved, That Colonel Kearney and Captain Du Pont, with the two Secretaries, be a committee to superintend the transfer of all property appertaining to the Light-house Department from the late Superintendant to the Light-house Board.

Passed.

Resolved, That the Secretaries forthwith ascertain and report the periods to which the light-houses on the Atlantic and Gulf coasts are respectively now supplied with oil.

Passed.

Adjourned till 12 M. Monday next, 11th inst.

W. B. SHUBRICK,
Chairman.

THORNTON A. JENKINS,
EDM'D L. F. HARDCASTLE, } Secretaries Light-house Board.

EXTRACTS FROM THE MINUTES OF PROCEEDINGS OF THE LIGHT-HOUSE BOARD.

SEPTEMBER 4, 1854.

The following communications were submitted * * * from Lieut. * * * United States Navy, August 11, 1854, at that time inspector of the * * light-house district:

The board took into special consideration the following paragraph in Mr. * * * letter, viz:

"In reply to the letter of the 18th, whilst I shall endeavor to make myself as familiar with the 'Instructions and Regulations,' &c., of the Light-house Board as my numerous duties will allow, and cheerfully to carry out not my own, but the views exclusively of the Board, through whatever channel they may be communicated to me, I must, at the same time, respectfully decline to make reports of my duties to a junior in rank; although quite willing to direct my communications (for yourself as the Chairman of the Light-house Board) to him."

Lieut * * * having been relieved from duty as light-house inspector before the reception of this letter, the board does not deem it necessary to reply to that portion of his letter of the 11th August, in which he declines to make his reports to the Naval Secretary of the board, in consequence of the latter being his junior in rank in the Navy, as quoted above.

The board, however, deems it proper to note upon its journal that it acquiesces in no such views. The law constituting the Light-house Board places the inspectors under the authority of the board, of which
both the Secretaries are members, as well as executive officers, and are the authorized and proper organs of communication between the board and all persons doing duty under it.

* * * * * *  
W. B. SHUBRICK, **Chairman.**

THORNTON A. JENKINS, **Naval Secretary.**  

---

**DECEMBER 9, 1854.**

* * * * * *  
The Naval Secretary submitted to the board two vouchers transmitted by the superintendent of lights at * * * * *, certified by Lieut. * * * *, United States Navy, light-house inspector of the * * district, one for medical attendance upon the inspector, amounting to $25, and the other for hire of room and attendance of a nurse for him, amounting to $50. The board directed that these vouchers be returned to the superintendent of lights at * * * * *, with instructions to call upon the light-house inspector to return the amounts to him, and to cancel them on his books, as they cannot be authorized to be paid out of the Government funds. The board further directed that Lieut. * * * *, United States Navy, be informed that by the act of August 31, 1852. creating the Light-house Board, no office of the Army or Navy, employed on light-house service, can be allowed any extra compensation whatever, and that, therefore, the two bills, for medical attendance and for hire of room and attendance, cannot be authorized to be paid by the Government.

* * * * * *  
W. B. SHUBRICK, **Chairman.**

THORNTON A. JENKINS, **Naval Secretary.**  

---

**MAY 29, 1855.**

* * * * * *  
From Lieut. * * * *, United States Navy, light-house inspector of the * * * * light-house district, relating to change in position of the * * * * light-vessel: Ordered, that the following letter be sent to Lieut. * * * *, United States Navy, in reply:

**OFFICE LIGHT-HOUSE BOARD,**  
**MAY 29, 1855.**

**SIR:** Your letter of the 23d has been received and laid before the board. I am instructed to say, that the board reserves to itself to judge of the degree of "importance" to be attached to complaints which may reach it in any way, touching matters which relate to aids to navigation.

The board infers from your letter that the light-boat at * * * *, has been removed from its proper place, and takes it for granted that
you have taken proper steps, as instructed in the letter of the 21st inst., to return it to its position, and that no change, however comparatively unimportant, will again be made in its position, without instructions from this board.

If it is your wish to be relieved from duty as inspector, the board, I am instructed to say, will make application to the proper Department for another officer.

Very respectfully,

THORNTON A. JENKINS,
Naval Secretary.

* * * * *

W. B. SHUBRICK, Chairman.

THORNTON A. JENKINS, Secretaries.
EDM'D L. F. HARDCASTLE.

REPORT.

To the Professors A. D. BACHE and Jos. HENRY,
Committee, &c., &c., U. S. Light-house Board:

BALTIMORE, December 26, 1854.

GENTLEMEN: I have the honor herein to make report of the experiments, with whose conduct you some time since were pleased to charge me, upon the Numerical System of Light-houses, which has been proposed by Charles Babbage, Esq., and which aims at introducing, by means of appropriate periodical occultations, a more marked and better distinction among lights than the characteristics employed hitherto afford; so as, among other things, to enable the mariner, without previous acquaintance, readily, accurately, and certainly, to identify any and each individual light visible on the coast or harbor to which he is approaching.

These experiments would have been made, and their progressive results, earlier, had I not expected, agreeably to information I received, that Mr. Babbage himself would have been present in the course of the past autumn, to institute, or at least direct them. So soon as it was ascertained that this expectation would not be realized, the subject was taken up, and all the necessary preliminary experiments performed, of which the following is intended to give account.

The documents transmitted to me for my instruction and guidance consisted of, 1st, Notes respecting Light-houses, by Mr. Babbage, printed on p. 156, et seq., of the Report of Officers constituting the Light-house Board, &c., Washington, 1852; 2d, MS. copies of two communications from the same gentleman to Professor Bache, under date of August 28, 1853, and January 21, 1854, respectively; and, 3d, MS. copy of a Statement by the Commissioners of Northern Light-houses, (of Great Britain,) with reference to the plan proposed by Mr. Babbage for distinguishing lights. All these documents have been read and considered.
The first and second contain theoretical and practical suggestions of the inventor upon the merits and mode of establishing his system. The last sets forth general critical objections to it, and the mixed reasons which governed the decision of the Scottish Commissioners in declining to permit its adoption.

The aspects presented in this last document were, of course, not intended to be referred to me otherwise than as incidental to the general topic, as it had come before the United States Light-house Board. I might, indeed, have understood them as having been adjudicated and disaffirmed in the very act of committing to me the specialty of instituting experiments which would have been superfluous had the American Light-house Board accepted the broad grounds of the Northern Lights' Commissioners. There would, therefore, be no propriety in my referring to, even, much less discussing, any of the points in those grounds, further than as they touch and effect the physical theory of Mr. Babbage's plan, and of the experiments suitable to its illustration and perfection.

One of these points, to be sure, not thus physically connected, I had begun, upon your first reference to me and in advance of acquaintance with the document in question, to inquire into, with the view of ascertaining statistically the actual efficiency of the present system of distinction, and so the extent of desirable or necessary improvement. I had been accustomed to regard, perhaps without sufficient knowledge, not being a mariner myself, and my opportunities for observation having been chiefly confined to occasions, at one time not infrequent, along the Chesapeake bay and the ocean shore adjacent, such extent for improvement as quite considerable; and I supposed that a statement which would give the whole distance of coast lighted and accessible to vessels, and the whole number—1st, of lights existing along that coast; 2d, of vessels visiting it in any given period, say twelve months; 3d, of wrecks occurring during said period; 4th, of wrecks occurring either when or because the adjacent light-houses were not visible; and, 5th, of wrecks occurring either when or because the said lights, or any of them, were mistaken or could not be identified, would afford data proper for a precise and reliable determination of the question. But to obtain conclusive materials for such a statement, I found beyond my means; and the only resort which I had for the last items, viz: the register of claims for losses against marine insurance in this city and in New York, soon showed that from these at least was to be expected no fruitful result.

It seems plain, however, that the partial statistics, though doubtless accurate as far as they go, of the coasts of Scotland, do not exhaust the condition of the question; and that the ratio of the whole number of night shipwrecks to the cases among them where the lights were seen but not recognized, is only one of the elements for its solution. Thus, it is manifest that this ratio must be, among other things, inversely as the whole number of lights on the coast; i. e., that it must increase just as the whole number of lights diminishes. For instance, if we suppose, for the sake of illustration, that the number of lights on a given coast is diminished to unity, there could be no question as to the identity of this single light whenever it was visible, and thus all the shipwrecks occurring on that coast, which probably under such circumstances would
be very numerous, might be quoted, according to the view of the docu-
ment referred to, to sustain formal conclusions like its own, although
here completely erroneous. In the same manner, this ratio might be
shown to be materially influenced by other particulars. But this point
need not be dwelt upon further.

The next one is more aptly connected here, viz: the loss of illumi-
nating power accruing upon Mr. Babbage’s plan, by all the difference
in brilliancy between revolving and fixed lights. There is no doubt
that such a difference does in fact exist; that it is unfavorable to fixed
lights; and that Mr. Babbage, in his printed document, has prescribed
these last as essential to the adoption of his plan. It becomes, there-
fore, of interest to define what is the amount of this difference in gene-
ral; and also to ascertain how far the actual or possible mechanical
arrangements of the proposed plan tend to increase or diminish it.

If the difference between the two classes of lights were so great as to
render it expedient, irrespective of Mr. Babbage’s plan, to disuse fixed
lights altogether, the question would, of course, be either settled sum-
marily, or at least restricted to the determination of features in the new
plan increasing the efficiency of said fixed lights. But in point of fact,
the supposition does not hold, since so far from fixed lights being ineffi-
cient or disused, a large proportion, (nearly one-half, I suppose,) of the
great sea lights on our coast, at least, is of this character. There can
logically, then, be no absolute exclusion of Mr. Babbage’s plan on this
account, and no argument against it at all, in all those tolerably numer-
ous cases where fixed lights are at present actually employed. Such an
argument could only apply to the cases of converting existing revolving
lights into fixed ones.

The amount of brilliancy lost by such conversion has been ordinarily
and in professed treatises stated but vaguely. Thus, Mr. Alan Stiven-
sen, on this point, merely says that “it seems to be a natural conse-
quence of the physical distribution of light that fixed lights which illu-
nimate the whole horizon should be less powerful than revolving lights
which have their effect concentrated within narrow sectors of the hori-
zon.” And the document of the Scottish Commissioners, already re-
ferred to more than once, uses terms not less general, though more
emphatic, when it says, that “the conversion of revolving lights to fixed
lights would prodigiously deteriorate their power;” or again, when it
suggests that “the enormous difference of power between a fixed and a
revolving light must be obvious to any one who is acquainted with the
optical principles on which light-house apparatus is constructed.”

The actual ratio of brilliancy between the two classes admits, to be
sure, of being calculated only for separate cases where the elements of
the apparatus are given, and its range or the distance of the observer
is assumed. This last item affects, of course, materially fixed lights,
the mass of whose rays more divergent is subject to the ordinary law
of intensity diminished in proportion to the squares of the distance at
which they may be observed, while the brilliancy of the more parallel
beams of the revolving lens or mirror is, theoretically at least, indepen-
dent of distance. But these terms must be taken altogether as com-
parative; for while, in the fixed apparatus, the diverging rays of the
unassisted lamp-flame are so far paralyzed as to be augmented in intensity several hundred fold, in the revolving apparatus provision is made for an amount of remaining divergency, without which a parallel pencil could produce but the briefest flash, perhaps imperceptible, and, at most, hardly useful.

The trouble of calculations, however, may be dispensed with for our present aim, by resort to experiments, which gave, with as much precision as belongs to photometric methods, or as is required for practical purposes, ratios of brilliancy that may be considered constant. Such experiments have been reported by Mr. Leonor Fresnel upon annular lenticular apparatus, as follows:

<table>
<thead>
<tr>
<th>FIRST ORDER.</th>
<th>SECOND ORDER.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed light, constant brilliancy..............</td>
<td>560</td>
</tr>
<tr>
<td>Revolving light, maximum brilliancy.</td>
<td>4,400</td>
</tr>
</tbody>
</table>

It is obvious that we need not compare lower orders; both, because, where they are suitable, there is no question of the sufficiency of fixed lights, and because the experiments show that as the size of apparatus diminishes, the lustre, whether in motion or at rest, tends to approach equality.

Such, then, are the relations of absolute brilliancy. But this is not the only relation that should be taken in account, for it will be observed that while the brilliancy of the fixed light, such as it is, is constant and uniform in every azimuth around the whole horizon, (except only those small spaces where the vertical opaque joints of the lenses and framework are interposed,) that of the revolving light is but momentary in a given azimuth of extreme narrowness, (being seven times as bright as a fixed light on an arc of less than 1,000 feet at a distance of ten miles,) which it leaves again in darkness for a shorter or longer period according to the rate of revolution of the apparatus. The effect, therefore, of this last class can be useful in the photometric ratio of its brilliancy only in that particular azimuth; and hence, to establish and compare the absolute useful effects in navigation and to vessels that may be assumed to need the light at the same instant in different azimuths, it is necessary that the numbers representing the brilliances be combined with the lengths of the circular arcs respectively subtended.

When this is done, throwing out all accessory parts common to both classes, we have the following proportions:

<table>
<thead>
<tr>
<th>First order.</th>
<th>Second order.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed light, useful effect.</td>
<td>1.0368</td>
</tr>
<tr>
<td>Revolving light, useful effect</td>
<td>0.9484</td>
</tr>
</tbody>
</table>

In which the calculation agrees with observation, that as the remote-
ness of range becomes of less moment, the advantage of fixed lights increases.

Consistently, then, with these statements, both of useful effect and of absolute brilliancy, it may be concluded that wherever the offing, requisite for the warning of the mariner and the safety of the vessel, does not exceed the range of a fixed apparatus, there is no reason, except for distinction's sake, to erect any other.

This condition, I am informed, exists extensively along our northeastern coast, where the task of the navigator at present is to distinguish, at distances fully penetrable by a fixed light, among various inlets, often not very remote, what is his proper course. Here, then, for instance, and elsewhere, where like conditions are found, the plan of Mr. Babbage is fully admissible.

It should be, and is, among the experiments you have authorized me to institute, to observe how far the alternation of light and darkness in the occultations, upon Mr. Babbage's plan, tends to increase or diminish the efficiency of a given light. That the space-penetrating power of the rays themselves should be augmented, is not probable; but that, within the limit of penetration otherwise, the sensibility of the retina of any observer should become more acute by the alternations of these opposite states, is quite likely. Such was, in fact, the case with myself in some observations I have already made, but the range used was so short as not to allow any positive, universal deduction to be predicated.

In order to try this point most suitably and conclusively there ought to be a second light, equivalent with the first, placed alongside, so as to afford continually a standard for comparison. But as to establish a double arrangement of this kind, if possible at all, would be, I presume, very inconvenient, I limit myself to its mere mention, anticipating a reasonably reliable result from alternating observations of the same light, now left to burn steadily, now undergoing successive occultations.

Finally, in connection with this whole question of difference in lustre between fixed and revolving lights, it is to be observed that though Mr. Babbage's printed notes referred to the use of the former, yet his manuscript communications subsequently indicate how the distinctions of a numerical system may be attained upon the latter also. But as these modifications appear to me of secondary importance, I have thus far postponed their study, and am unprepared to express any opinion.

After these preliminaries, which I begin to fear you may find more than sufficiently tedious and out of the record, I can now pass to the proper subject of this letter, namely, the method and results of the observations that have been made and of the experiments that have been tried.

The illuminating apparatus used was a third-order, large size, annular Fresnel lens, with a cupola, now somewhat ancient, but in tolerable repair. It was fitted with three revolving external lenses for eclipses; of which, however, I made no use further than sometimes to fix them in the direction of the observing station, in order, by the increased intensity of the light thus afforded, to have a virtual effect of variation in the range.

The place for its erection I owe to the courtesy of the managers of
the Maryland Institute in this city, who allowed the large south chamber in the third story of their hall to be used for its accommodation. As the lamps which accompanied the lens did not work very well, and for other reasons of cleanliness and convenience I preferred for its illumination to use gas, with a suitable burner that preserved the normal volume of flame corresponding to the capacity of the lens. I made no special observations upon the different intensities of light from the oil lamps and from the gas burner, as not affecting practically the subject. In general, however, I may say that the gas light was the more brilliant of the two.

The place from which it was intended to be observed was Fort McHenry, lying distant about two and a quarter miles across the river. After some trouble, however, it was found that this could not be occupied, the lens having become hidden, I believe, by some buildings erected since it was put up first. The station actually used was the Merchants' Observatory on Federal Hill, distant less than a mile, but with a wide extent of the harbor intervening. This water surface and the vapor rising from it and from various steamboats, together with the smoke of the city itself which descends upon the harbor, produced upon the light itself, as I had occasion to notice repeatedly, an effect corresponding to a much augmented distance in a purer atmosphere.

The mechanism for the occultations was arranged to be worked by hand, in order to leave the utmost scope in these preliminary experiments for the variety of combinations that might be demanded. It consisted of a cylindrical chimney of sheet iron, with a collar of brass below, fitting, when down, to a corresponding balcony on the burner, worked through a vertical lift of five inches along steel guides by a lever forked at one end to embrace the diameter of the chimney, and flattened at the other into a convenient finger-key, while its fulcrum was on an upright shaft hinged to the general base of the mechanism, and, by its rocking motion, preserving the parallelism and verticality of the cylinder. A metronome, adjusted to beat seconds, furnished the means of counting time, and two assistants were readily trained, the one to work the apparatus, the other to count the intervals and check off the programme of the various operations for each night's work.

After this had been arranged, it was my habit to resort to the Observatory station with another assistant, who either announced the occultations while I observed the time with the seconds' watch, having but one metronome, or counted the time while I noted the occultations. But I soon was able, after a little familiarity, to dispense, except occasionally, with any reference to the watch, (especially in the last systematic series,) it being easy to count time in the head with an accuracy sufficient to prevent any mistake or confusion.

When the mechanism was ready for work, the first point to be determined was the character of the occultations and reappearances, whether they should be sudden or gradual. And this was tried in all phases, by—1st. Lifting the cylinder suddenly, and, at the end of the given period, letting it drop suddenly; 2d. Lifting suddenly, and, at the proper period, letting it descend gradually; 3d. Lifting gradually and then allowing a gradual descent; and, 4th. Lifting gradually and dropping
suddenly. Of these, the most characteristic in its effect upon the retina was the last. But in the actual experiments subsequent, partly on account of the difficulty of producing by hand a uniformly gradual elevation, and partly because I found the same phenomenon imitated in some sort by casual vails of vapor or smoke that swept between the lens and me, the first phase was alone employed, which gave besides a sharper and more certain definition of the periods.

The next thing to be settled was the duration of the occultations. A period of one second I found too short to obliterate the impression of the previous lustre; a period of two seconds was more satisfactory in this respect, but it was sometimes embarrassed and confused by the nearly similar duration of those obscuring currents of which I have already spoken; a period of five seconds, which was then tried, was obviously in all respects unnecessarily protracted, and I finally settled down on one of three seconds as affording the maximum of advantage, at least under the local circumstances of the experiments, and, I incline to think, universally.

These points having been established, there were manifestly two systems under which they might be applied and the object attained—

1st. By causing occultations, of constant duration, to alternate with reappearances whose repetition should indicate the number of digits intended to be expressed, while their varying periods of duration should be characteristic of the numerical place of the digits, respectively; or,

2d. By causing occultations, of constant duration, to occur as many times during a given period as there are digits to be expressed. Either of these contains, I apprehend, the substance of Mr. Babbage’s plan.

In the second system which happened to be tried first, (and the most simple to work,) it is obvious that the period during which the occultations occurring are to be counted, has a practical limit, and that, in general, it should be as short as possible. The shorter this period, the more expeditious is the determination of the number of digits expressed, i.e., of the number of the light-house in question. Further, it is to be considered that one count of occultations, during an assigned period, might not be always satisfactory enough to be relied on, and therefore it would be fair to allow twice the assigned period for the ascertainment of the number in question.

Again, on the other hand, the shorter the period assigned, the less with occultations of constant duration will be the number of digits that can be expressed; and, in so far, the scope and fecundity of the system itself become limited.

On consideration of all these points, and of some others which do not require mention, I took, as a convenient period, one minute, which answered very well, provisionally, for these experiments, and I suppose, would be suitable universally. I took, also, finally, for the duration of occultations, three seconds, as had been shown before to be most advantageous, but only after having repeated and compared other durations up to five seconds in experimenting upon this very subject.

Of course, with these definitions, the expression of the digits or the numerical value of the phenomena will be—

For one digit, or light-house No. 1, one occultation per minute;
For two digits, or light-house No. 2, two occultations per minute; for three digits, or light-house, No. 3, three occultations per minute, and so on.

These may be arranged with greater clearness in the following table:

<table>
<thead>
<tr>
<th>No. of light-house</th>
<th>Period of illumination</th>
<th>Period of occultation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>2</td>
<td>27 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>3</td>
<td>17 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>4</td>
<td>12 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>5</td>
<td>9 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>6</td>
<td>7 seconds</td>
<td>3 seconds</td>
</tr>
<tr>
<td>7</td>
<td>5\frac{1}{2} (6)</td>
<td>3 seconds</td>
</tr>
<tr>
<td>8</td>
<td>4\frac{1}{2} (5)</td>
<td>3 seconds</td>
</tr>
<tr>
<td>9</td>
<td>3\frac{1}{2} (4)</td>
<td>3 seconds</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>3 seconds</td>
</tr>
<tr>
<td>&amp;c.</td>
<td>&amp;c.</td>
<td>&amp;c.</td>
</tr>
</tbody>
</table>

Beyond the No. 10, however, where the illumination and occultation become of equal duration, it would not be suitable to go with the assumed period of one minute; which period, considering all its practical advantages, it would be hardly advisable to increase.

The application, then, of this system will be to arrange the lights in groups of ten; the distance between any number in one group and the same number in the adjoining groups being supposed great enough to prevent any possibility of mistake. Such distance would probably be about 200 miles, a space beyond any assumable error in reckoning.

Of course, the individuals in any group would not be arranged in numerical order, but in such sequence as would allow of the utmost difference between each. For instance, I arranged them, in repeating the experiments, in the following succession:

First group. 1 4 7 10 2 5 8 3 6 9  Second group. 1 4 7 10, &c.

Here a mistake of at least three occultations would have to be made in the count in order to produce confusion between any adjacent lights. A mistake of a single occultation corresponds to a space of sixty miles in reckoning. I can affirm from experience—in the comparative quiet and safety of a station on land, it is true—that a single observer need not be in error to amount of the greater of these mistakes in any case; and that it would be difficult for two observers, one watching the light and the other counting time, to be as much out as the least of them. What allowance in this respect should be made for storm and darkness on ship-board, I have no means of estimating.

It must be admitted, however, that this system has the disadvantage (as the document of the Scottish Commissioners has in substance indicated) of requiring the simultaneous observation of two phenomena, viz: the disappearance of the light, and the movement of the index of a time-keeper; and although, with suitable provisions, this double observation need not be a source of uncertainty, it still remains in its nature an element of embarrassment. Withal, this system does not materially
increase the scope of distinctiveness as possessed already by existing ones; although the individual distinctions it affords are, in my judgment, more characteristic and reliable. I therefore willingly turned the experiments to the other system first indicated, as the most appropriate in theory and most fecund in application.

This, which, as already said, consists in the alternation of constant occultations, with reappearances of varying duration, demands, when those variations of duration are well characterized, no reference to a time-keeper on the part of the observer, and reduces his task to the phenomena of the light only. Here he has, to be sure, two things to notice, viz: 1st, the characteristic durations of the illuminations, and 2d, the number of repetitions of each, or, what is the same, the number of occultations under each character. But in regard to the first, the distinctions are susceptible of being made so emphatic as not to call for any special exercise of the faculty of comparison; and the second, which is virtually the sole item, is so simple as to require in no case any other mechanical adjunct than the fingers.

Of course, in this system, as in the other, there is a practical limit to the durations that can be adopted; and more than in the other will there be occasions for a second observation, or a portion of a second observation, to supplement or confirm the first. This will be more apparent hereafter.

It is not necessary to detail the trials I made of various characteristic periods, in order to see which would combine the greatest advantage in all regards. It is enough to say that, after several such trials, I came to settle down on the following, viz: a constant duration of 3 seconds for the occultations; a period of 3 seconds illumination for units, of 10 seconds for tens, and of 20 seconds for hundreds. Further, I arranged that these should read, as it were, from left to right—i.e., that the account should begin in the mechanism with the digit of the highest place. And I did not find it necessary to interpose any pause to indicate the completion of the count of the proper number, but allowed the mechanism, after the occultation which followed the last repetition of units, to recur at once to the repetition of hundreds, if there were hundreds, or of tens, if the number of digits did not exceed that rank.

For example, to express the number 345—the highest, I believe, that is likely to occur on our coast—the mechanism, supposed to start from a state of rest, i.e., from an occultation, will show the light for 20 seconds, followed by an occultation of 3 seconds, three times; then for 10 seconds, followed by the constant occultation, four times; then for 3 seconds, followed by the constant occultation, five times; then for 20 seconds, followed, &c., as before; and so on, without intermission.

Perhaps this will be more plain, by exhibiting the actual programme furnished to the assistants at the lens, so far as covers this single number, thus:
Programme, &c., for No. 345.

Cylinder.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 sec.</td>
<td>2 sec.</td>
<td>20</td>
</tr>
<tr>
<td>3, hund.</td>
<td>20 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>20 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>20 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td>4, ten</td>
<td>10 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td>5, unit</td>
<td>3 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3 &quot;</td>
<td>3 &quot;</td>
<td>1</td>
</tr>
</tbody>
</table>

Repeat 10 times.

Signal to prepare: 2 sec. 2 sec. 20 &c.

These signals to prepare were merely arrangements for convenience between the assistants at the lens and myself, to indicate the passage to the execution of a new number. Further, I had also a pre-concerted set of fire-signals at my own station, watched for by a third assistant, of whom I did not speak before, at the lens, by means of which I was able to direct the suspension of any particular number during its execution, or its repetition to a greater number of times than prescribed in the programme, or the passage to another number at discretion, &c., and also to make other communications that might occasionally become necessary.

I found no difficulty at any time, by a slowly-uttered count, one, two, three, &c., (independent of the second’s watch, and capable of being originated by any one, who has a notion of time in his brain, from the beats of his pulse,) in identifying beyond the risk of mistake any of the numerical ranks, and thus readily distinguishing between the hundreds, tens, and units; and after a while I found that even such oral count was dispensable, and that the difference of duration fully characterized the rank of the numbers that were being executed.

My assistant at the station, who had not previously been accustomed to such observations, speedily became as expert as myself; and, although generally left purposely in ignorance of the number that was intended to be executed, did not fail to announce it correctly after two counts, and, ordinarily, after one.

It will be at once seen that it is no matter at what part of the revolution of the mechanism the count is begun to be kept, the characteristic durations unfailingly point out the order of numerals which are being executed. Thus, supposing, in the example of the schedule just given, that the observer first begins to notice in the middle of a revolution, (which will be the most disadvantageous point,) i. e., when the mechanism
is executing the first of the tens; he will at once recognize the character
istic of rank, either instinctively or by an oral count; and he will
go on to count three tens, when an emphatic change in the durations
will show him that he must reckon units, of which he will then count
five; when he will perceive a still more emphatic characteristic intro-
duced which will assure him of the termination of the number, (i. e., of
its last figure,) and also that the proper number is among hundreds.
When he has counted through the hundreds and through the tens, he
need not, except for confirmation, count any further, for he will have
the number in full.

If, further, a similar disposition be made of the lights in this as was
spoken of for the other system, viz: out of the regular numerical
sequence, whereby numbers that differ but slightly would occur at
remote intervals, the proper number will be ascertainable inferentially,
even before the full count is completed.

Of course, to make one such full count with high numbers consumes
time. Thus, to count the number 299, which is the longest up to the
limit before supposed likely to exist on our coast, requires, assuming
the count to be commenced in the middle of a revolution, (the least
advantageous point,) four minutes thirty-two seconds. To count this
number twice, consecutively, would require eight minutes nine seconds.
I am unable to speak, of my own knowledge, as to whether periods like
these would be, upon critical occasions, admissible or not. The former,
at least, I should suppose, would not be, in general, too long.

But if it should be judged to be so in particular localities, a remedy
might be had by disposing the low numbers at all those points where
the offing is precarious, and where the mariner cannot afford to be so
long as five minutes without an identification of the light. The high
numbers would then occur in those situations where a few minutes, more
or less, would not be of disastrous consequence.

To look at this topic of time in another aspect, perhaps more curious
than useful, it may be observed that the mean time of counting all the
available numbers of the whole series, extending to 350, is less than
two minutes, or, more nearly, 113 seconds.

The term available numbers, is used here because there are, as will
readily suggest itself upon reflection, some numbers in the series that
cannot be expressed without having an additional signal to signify zero;
and some, also, as the entire unit series from 2 upwards, that cannot be
executed without a still additional signal to indicate a stop. It seemed
to me better to surrender the numbers of this sort than toumber the
system with multiplied signals.

In point of fact, it is not all the numbers containing or terminating
with zero that need be excluded, but only those where there is but one
significant figure and that one greater than unity. Thus, the number
10 is expressible, and also 100, by their appropriate characteristics; the
former after ten repetitions, and the latter passing three (under the pre-
ceding assumption of the whole number of lights being less than 400)
being recognizable as unitary. But the numbers 20, 30, 40, &c., and
200, 300, &c., could not be recognized. Where the significant fig-
ures are in two places, the want of a signal for zero produces no confusion. Thus, 102 and 120 can be readily identified, and so of others.

It will be found, then, in this way, that only eighteen numbers have to be surrendered out of the whole three hundred and forty-nine, and that the abandonment after all is in reality of no moment, since the same discount holds good up to 400; and the system itself with its present equivalents and the loss of but six more unavailable numbers goes up to 999—a large fraction of all the light-houses on the globe.

I consider, then in view of all that has been said, that this system may be advantageously applied at any and all points where the range demanded does not transcend the power of a first-order Fresnel lens; and as I am not informed of any existing requirement greater than this, I take it further as applicable without reserve along the whole coast.

In order, however, that it may have the advantage of criticism by other observers, and an exemplification (as I anticipate) of its utility, I beg to suggest that I be allowed to erect temporarily the present lens, or some other with appropriate self-acting machinery, in some actual light-house. If this suggestion meets your approval, the Bodkin light at the mouth of the Patapso will be a convenient place, being easily visible from the city, and at a distance about 15 miles across land and water, adequate to developing all the good and bad points of the system as cannot be predicated of the limited range I have been able to use hitherto.

I have not yet had the opportunity of ascertaining how far the lantern at the Bodkin is capable of accommodating the apparatus; but presume that it is sufficient.

Of course some time must elapse, after the authorization asked for here shall have been obtained from the Light-house Board, before the apparatus can be erected, not so much on account of the preparations necessary as for the due publication of notice to mariners which should precede any change in an established light. I am uninformed as to the length of time allowed for this last object, but can undertake to have all the mechanical arrangements in readiness for any given day after 31st January next. To transport and erect the apparatus will require one day.

In respect to the mechanism necessary for working the occulting cylinder, which is already in great part designed, I have not thought necessaries to delay this report until I had prepared and could copy all the drawings for it, because it is extremely simple. The descent of a weight requiring to be wound up only once during a long winter night, furnishes the maintaining power which is communicated through a short train and regulated by a short counter-weighted seconds' pendulum, which, considering the avoidance of repairs, I prefer to a fly governor. On the arbor of the swing-wheel can be adapted at pleasure any of the cams working the lever-lift for all numbers which can be executed in one minute or less, which I take to be enough for the present purpose, or this adaptability may be extended to those numbers even which require two minutes and under. In actual practice, when each individual num-
ber will have its own separate machine, it will be better to gear the cam-shaft to the wheel-work elsewhere than at the scapement.

The necessity for machinery at all, and the inconvenience of readily replacing it with a duplicate, constitute with me, in the abstract, the most serious objection to the new system; as, however, this is an objection that applies equally to all revolving machinery and to the lights of that class, and also in a measure to the clock-work for the oil pumps, and as better than in either of these cases, the occultation machinery can be provided for by hand through an entire night if need be, the new plan stands in fact upon an equal footing with existing ones. The nature of the work to be done, besides, allows and even requires that the machinery be very strong and substantial, and in so far the risk of accidental disorder becomes less; nor would this risk be increased by gearing it on (as will be very easy) to do also the work of the lamp pumps. By this modification the construction of the lamps themselves will be cheapened and improved, and the aggregate machinery of a light-house would be lessened in quantity, cost, and in liability to disaster.

In relation to the other uses of which Mr. Babbage's plan is capable, such as telegraphic signals along shore, to and from vessels lying-to or in distress, &c., I have considered it more likely that a full and just conclusion would be arrived at ultimately in the premises by confining the present inquiry to its main and more immediate feature of utility, than if it were complicated by the consideration of various incidental applications, in the adoption of which regard has to be paid to more than mere mechanical arrangements or adaptability. And I have accordingly so confined it, leaving those incidentals, though seen clearly to be of great philosophical interest and public convenience, to their own gradual development, or at least to future investigation.

In the hope that the several considerations that have been presented will appear to you satisfactory, and that the conclusions arrived at will meet your approval, and awaiting your further directions in the premises, I have the honor to remain, gentlemen,

J. H. ALEXANDER.

THORNTON A. JENKINS, Esquire, U. S. N.,
Secretary, &c., &c., U. S. Light-house Board, Washington, D. C.

BALTIMORE, June 26, 1855.

SIR: I have the honor herewith to enclose the report of Professor Morfit, of the University of Maryland, and myself, upon certain samples of oil which you caused to be forwarded to me in January last, for examination and analysis, and which have been attended to with all the expedition compatible with the extent and accuracy of the research.

The aim, as I considered, should be not only to determine the existence of adulterating ingredients with sperm oil in two of said samples, and, consequently, the factiousness of those samples, and also the character and degree of adulteration so as to be able to assign, with a
certain precision, the respective proportion of each; but also able to devise some method of easy application by which these points could be hereafter ascertained with tolerable approximation in the practical inspection of oil which the light-house service is understood to require.

This extent of aim, of course, extended also, varied and multiplied the processes that would have been ordinarily requisite in a less conclusive and more limited examination. I hope that the object I thus held up to myself, is one that you likewise desired and approve; and that the discretionary labor bestowed in its attainment has been discreetly bestowed, and will not be regarded as incommensurate or inconsistent with the general plans of the board, of which I can but imperfectly judge.

The research, in respect to the two first-named points, will be found, I think, to have been attended with reasonable success; and as among the evidences of this, I have caused to be put up and transmitted to you, a number of bottles, two of which contain some of the H. oils, respectively, and the rest hold certain artificial oils, which all correspond more or less with the facetious samples of H., while a few of them represent and are to be considered as reproducing with physical identity those samples, respectively. These bottles are all lettered according to the numerical sequence of the mixtures mentioned on page 6 of the report, and can be in this way identified.

Now, if the proprietor of the H. oils can constantly distinguish his own oil among these samples, (except possibly by the smell of one of them,) he will be in possession of a faculty or a test (as the case may be) not ordinarily exercised by or known to chemists. And even then a capital difficulty will remain, viz: to show that several of the artificial oils are practically different from and inferior to his own.

In the nature of the case, this is the best proof available for showing that the problem you have submitted to me has been solved. For, as you will perceive when you peruse the report following, hardly any of the tests applicable are absolute in theory; while even these are liable in practice to be restricted and masked by the slight irregularities and variations in composition and externals, so frequently found in different samples of the same organic substance. Therefore, it is that in such cases as in the present, we are forced to resort to comparative methods, which act, as it were, by exhaustion, and to rely on (so to speak) circumstantial evidence.

In regard to the last-named point of research, viz: the device of some method of inspection by which the identity or difference between given samples of oil and a standard specimen can be promptly and reliably ascertained, the following conclusions may be considered as settled:

1st. That there is a certain rise of temperature produced by the addition of a half-volume of sulphuric acid of commercial density to any given volume of either of the three natural oils—sperm, whale, and lard—herein considered, appropriate to the said oils respectively, and constant for the same oil within a degree or two of Fahrenheit's thermometer. To this rise of temperature under such circumstances, I have given the name epitherm, and so it may be said, in brief, that each
of these oils unadulterated (and probably all others) has its own characteristic epitherm.

2d. That this epitherm affords a reliable means of distinguishing among these, several oils in their natural state.

3d. That any mixture of any two of these oils has a characteristic epitherm which may be equated arithmetically within two or three degrees of Fahrenheit's thermometer, upon the proportionate quantities and epitherms existing before and at the time of mixture.

4th. That this epitherm also, taken with specific gravities, affords a reliable distinction between the said natural oils and any factitious mixture of them.

5th. That the epitherm, taken with specific gravity, affords a probable means of determining even the proportions of natural oils existing in the mixture within the limit (say 3° F.) of the errors of observation.

This last item is not so material in the practical inspection for lighthouse purposes, where, I apprehend, the object is to ascertain the identity of delivered samples with the sample contracted for, and still less material, so long as the contracts are made for pure sperm oil, whose epitherm is so far below that of any probable (I might almost say possible) mixture as even to render the observation of specific gravity unnecessary. If, for example, the rise of temperature does not transcend 72°.5 F., it may be safely said that the oil in question is an unadulterated sperm oil. If the lighthouse service should hereafter admit other than unadulterated sperm oil into its contracts, having an epitherm higher than this, the coincidence of epitherm and specific gravity respectively in the article contracted for and that delivered will render the identity of the two in the highest degree probable, or, as we say ordinarily, morally certain.

In view of the value of this index of identification, I respectfully suggest that you should consider the propriety of its being referred to in future contracts as an element to be observed and insisted on.

Should your consideration prove favorable, or should you, on the other hand, prefer the employment of the index in question, without announcing it, and so setting ingenious persons to work upon contrivances for evading it, I can very promptly describe, or, if you please, furnish the requisite apparatus, which consists only of a thermometer and a glass or porcelain beaker. It is necessary that these beakers should be, as nearly as possible, uniform in material, capacity, and mass, so that their absorption and radiation of heat shall be respectively the same.

These precautions would be of more and more importance if the method were to be applied (as it will without doubt come to be) in laboratories, inversely, as a means of analysis; but in its direct application for determining identity merely, they do not seem necessary to be dwelt on here any more than a good many other particulars which are of extreme theoretical interest, and may hereafter be of practical moment.

As under this aspect, for instance, I pass by any further details upon the new chromatic test for lard oil, mentioned in the report, whose utility in defining ternary mixtures, when such cases have been detected by the discordance of epitherm and specific gravity, and even in detecting such in advance, will, I anticipate, be hereafter recognized. As a means of
detection and determination in the simply adulterated summer sperms, wherein lard, I am informed, enters largely as an ingredient, its direct application would be of immediate value.

At a future and more favorable time, I think it would be worth while to take up the special subject of inspection of oil for the light-house service, and make it the topic for extended consideration and report.

In the meantime, with the hope that what has been said and done so far will meet your approval and be to the advantage of the light-house service,

I remain, sir, with great respect, yours,

J. H. ALEXANDER.

—

REPORT ON OILS.

The oils forming the main subject of this report were standard samples of winter and summer strained sperm oils and whale oil, furnished by Mr. E. M. Robinson, of New Bedford; a sample of lard oil, furnished by Messrs. George & Jenkins, of Baltimore; and two samples of oils furnished by Mr.——————, of———, both marked with his surname, and one bearing an additional indication of 40°, presumed to be of the temperature at which it was expected to remain fluid. All these samples, except the lard oil, the first specimen of which was in a glass pint-bottle, came to hand in well-secured tin cans, and appeared to be in good condition. The observations and experiments to which they have been subjected, and the results of their examination, are presented here briefly and orderly as follows:

PHYSICAL PROPERTIES OR EXTERNAL CHARACTERS.

1. Color.—This characteristic is only given here as ordinarily and formally necessary in any description of an article submitted to physical examination, but not as a conclusive or reliable test, for which it is both in the present samples too slightly marked, and in general too variable among different samples of the same kind. In point of fact, the color of all these samples (except of the lard oil, which is light-golden) is a sherry-brown, and the hue of each goes on deepening successively, though not by equal gradations, in the following order, viz: lard oil; H; H₄₀⁰; sperm ₄; whale; sperm₄₀. And the summer strained sperm ₀, which in constitution and source may be presumed to be the nearest to the winter-strained sperm₃₄, differs more from the whale oil in tint than does this last from the winter sperm oil.

2. Odor.—This characteristic, with perfectly natural oils, i. e., those which are quite unadulterated, is much more reliable than that of color, but even more difficult to be defined in words. The odors of the lard and of the whale, especially, are quite distinct; while that of the sperm is sufficiently marked to enable one, after some experience, to distinguish with tolerable certainty, by the faculty of smell alone, among the three; but in the case of factitious oils—mixtures, for instance, of the three that have been mentioned—this test becomes less permanent and decisive; for it is not difficult to adulterate, aromatically, the mixture so as, if not entirely to mask for sometime what ought to be the domi-
nant odor, at least to confuse the several ones to such a degree as to render their separate appreciation the work only of singular acuteness or of good fortune.

In the present samples the odor of the lard, whale, and the two sperms, appears of natural distinctness and intensity; that of the H. oil pleasantly differs from all the four, leading to the supposition, in the absence of all other tests, that some disguising aromatic had been added; while in the H. 40 the odor of lard leaves itself yet to be strongly suspected.

3. Density.—This is among the most precise and persisting characteristics of all oils, natural and factitious; and it was therefore ascertained with great care for the present samples, by counterpoising successively in each, in distilled water and in air at the same temperature, a ball of about an ounce troy weight, suspended on a delicate balance beam by platinum wire of about the 1/10 of an inch diameter. Of course the proper correction was made, at the rate of 0.047 grains per inch, for the varying immersion to the nearest tenth of an inch of the wire, according to the accidental difference of level of the water and of the oils, respectively, in the beakers containing them.

The results thus obtained, at a constant temperature throughout, both for the oils and for the water, of 64°.5 Fahrenheit, were as follows:

<table>
<thead>
<tr>
<th>Water</th>
<th>H. 40</th>
<th>0.91184</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm 44</td>
<td>0.87971</td>
<td>0.91546</td>
</tr>
<tr>
<td>Sperm 40</td>
<td>0.88056</td>
<td>0.92000</td>
</tr>
<tr>
<td>H.</td>
<td>0.91005</td>
<td></td>
</tr>
</tbody>
</table>

This temperature of 64°.5 F. is so near the English standard of 62° F., that it becomes nearly as useful, and more safe, to give results actually observed, rather than run the risk, by any more systematic statement, of the errors which are more or less apt to attend the introduction of constant factors for reduction.

It is seen, then, that differences of density are plainly marked among the natural oils; and that, among the present samples, it is an unmistakable test. It became of interest, then, to ascertain how far it would be permanent and reliable for mixed articles, i.e., whether in the alligation of the mixtures there was any change of volume occurring, which would complicate or embarrass the calculation of the proper densities of such mixtures.

For this were measured, with as much care as possible, equal volumes at the same temperature, of lard, whale, and winter sperm oils, which were then severally well mixed and the specific gravities of the mixture taken as before; only in this case the temperature at the time of observation happened to be 65°.25 Fahrenheit. The following were the results observed and compared, with the specific gravities calculated from the densities of the original oils, respectively, without change of volume:

<table>
<thead>
<tr>
<th>Mixed oils</th>
<th>Sp. Gr. observed</th>
<th>Sp. Gr. calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lard and sperm 44</td>
<td>0.89736</td>
<td>0.89736</td>
</tr>
<tr>
<td>Sperm 44 and whale</td>
<td>0.89905</td>
<td>0.89962</td>
</tr>
<tr>
<td>Lard and whale</td>
<td>0.91778</td>
<td>0.91750</td>
</tr>
</tbody>
</table>
Considering the difficulty of precisely detaching measured volumes of liquids generally, and especially of such adhesive and viscid ones as oil, it may be safely presumed that the deviations between calculation and observation shown above are attributable to this source. Even were they somewhat more serious than they are, the comparison of the results would still warrant the conclusion, that in mixed oils no change of volume occurs; that when the ingredient oils are known, the proportions in which they have entered can be precisely defined; and that when they are not so known, the density of the resulting mixture will often furnish a guide to their discovery and assignment.

Accordingly, it being inferred that the H. samples, from their rank in the table of densities thus given, and from certain other circumstances, were probably mixed articles, calculation was made of the proportions in which the four unadulterated oils would have to be taken, in order to yield mixtures of identical specific gravity with the H samples, respectively, as follows:

1. Binary combinations:

   3.05 parts whale + 1 part sperm₃₄ : No. 1.
   5.60 " lard + 1 " " : No. 2.

   for H.; and

   3.88 parts whale + 1 part sperm₄₀ : No. 3.
   8.64 " lard + 1 " " : No. 4.

   for H₄₀.

2. Ternary combinations:

   3.77 parts lard + 1 whale + 1 sperm₃₄ : No. 5.
   1. = " " + 2.5 " + 1 " " : No. 6.
   1. = " " + 1 " + 0.5 " " : No. 7.

   for H.; and

   6.39 parts lard + 1 whale + 1 sperm₄₀ : No. 8.
   1. = " " + 3.39 " + 1 " " : No. 9.
   1. = " " + 1." = " + 0.38 " : No. 10.

   for H₄₀.

In arranging these, sperm₄₀ was attributed to H₄₀ from the assumed analogy of their solidifying points, and before any special experiments had been made to determine these points. With this allocation, the binary combinations above are all that can be made—the ternary ones, on the contrary, are unlimited; but those that have been selected manifestly cover the limiting conditions of the question. It will be seen, presently, how other applied tests concur with while they restrict the selection.

The mixtures, then, according to these proportions, were made with all requisite precautions and reserved for the other tests just referred to. The specific gravities of two of them, taken at random, viz: the third of the binary series and the first of the ternary, were observed at the temperature of 62° Fahr., as follows:

<table>
<thead>
<tr>
<th>Mixture</th>
<th>Sp. Gr. 62°</th>
<th>Sp. Gr. 64.5°</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.77 L. 1 W. + 1 S₃₄</td>
<td>0.91089</td>
<td>H. = 0.91005</td>
</tr>
<tr>
<td>3.83 W. + 1 S₄₀</td>
<td>0.91182</td>
<td>H.₄₀ = 0.91184</td>
</tr>
</tbody>
</table>
The discord in these two results is within the correction to be applied for the differences of temperature; and it did not seem necessary after these to verify experimentally the densities of the other mixtures.

4. Fluidity. Observations were made on this upon the assumptions of cohesion being constant for the same fluid, while it probably differs in different fluids; and of such cohesion, therefore, and its reciprocal fluidity, being indicated by the number of drops that, under identical conditions, were required to make up a constant volume. And these assumptions were strengthened by the very appreciable differences that were noticed in the method of indication first employed, viz: the usual way of dropping into a graduated glass vessel, along a straight, small, and pointed glass rod from beakers containing the oils respectively. There is no doubt, however, that for this way, the quantity of liquid in the beaker, the rate of pouring and supply, (which is almost necessarily dependent upon such quantity, varies with it, and is shown, among other things, by the irregular intervals of the drops themselves,) and the angle with the horizon at which the rod may be held, materially affect the result. Another method, therefore, more troublesome but uniform, had to be resorted to in the use of a pipette holding about a quarter of an ounce weight of the several oils, filled successively to the same level, held vertically at a constant height above the recipient. These precautions seemed to cover all that was requisite to secure uniformity in the results. The pipette, of course, had to be cleaned carefully between each set of observations, which consisted of two or three on the same oil; and the temperatures were observed in the beakers at the moment of filling the pipette. The following were the observations:

<table>
<thead>
<tr>
<th>Oil</th>
<th>Temperature</th>
<th>No. of drops</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lard</td>
<td>61°.25 — 61°.5</td>
<td>46</td>
<td>½ fluid ounce</td>
</tr>
<tr>
<td>Whale</td>
<td>61°</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Sperm_34</td>
<td>62°.25 — 62°.5</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Sperm_40</td>
<td>63° — 63°.50</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>63°</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>H_40</td>
<td>63° + — 63°.50</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>133°</td>
<td>50 — 51</td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>147°</td>
<td>51 — 52</td>
<td></td>
</tr>
</tbody>
</table>

The temperatures were observed in the beginning and throughout, under the supposition that they were influential—a supposition which receives confirmation from the last two observations. Nevertheless, it was evident, both in relation to this topic and in general, that, unless with a much more elaborate and complex apparatus, the differences in the number of drops would not be sufficiently marked to offer any practically instructive result. Such a result was, therefore, aimed at otherwise.

For this an iron plate, 70.075 inches long and about 5 inches wide, was fluted along its whole length by semicircular grooves 0.4 inch in diameter, carefully planed and polished, and as nearly as possible exactly similar. One end was then raised 0 875 inch, (corresponding to an angle of 42° 31′ nearly,) and in each of the grooves, over a trans-
verse zero line, ten drops of the different samples of oil were allowed
to fall, respectively. The time and temperature at that epoch were
noted, as also at convenient daily intervals afterwards, and at each of
these successive epochs, the distance in inches run by the respective
samples was read off from the graduated edges of the plate. A good
many days were allowed to elapse, in the anticipation that some of the
samples would become entirely stationary; then the inclination of the
plate was augmented by another 0.875 inch (corresponding to an angle
of 1° 25' 21/2 nearly) and the distance run read off as before at several
epochs; and, finally, similar readings were made after the plate had been
still farther elevated by an additional 0.875 inch, and thus inclined at
an angle of 2° 7' 35½ nearly.

All these observations are included in the following table:
Table of the distances run by the several Oils and of their corresponding intervals, &c.

<table>
<thead>
<tr>
<th>Date</th>
<th>TEMPERATURES</th>
<th>EPOCHS</th>
<th>LAND</th>
<th>WHALE</th>
<th>SPERM. 34°</th>
<th>SPERM. 40°</th>
<th>H.</th>
<th>H. 40°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At observation</td>
<td>During maximum</td>
<td>Internal minimum</td>
<td>Whole N° of hours elapsed</td>
<td>Intervals</td>
<td>Run in inches</td>
<td>Velocity in inches per hour</td>
<td>Run in inches</td>
</tr>
<tr>
<td>Feb. 7, 1 h. 30 m.</td>
<td>69°</td>
<td>64°</td>
<td>47°</td>
<td>0</td>
<td>Angular</td>
<td>Inclination = 6° 42'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5, 11 h. 45 m.</td>
<td>65°</td>
<td>64°</td>
<td>47°</td>
<td>22.25</td>
<td>22.35</td>
<td>8.75</td>
<td>0.2023</td>
<td></td>
</tr>
<tr>
<td>9, 11 h. 50 m.</td>
<td>64°</td>
<td>64°</td>
<td>47°</td>
<td>45.31</td>
<td>24.08</td>
<td>19.20</td>
<td>0.4144</td>
<td></td>
</tr>
<tr>
<td>10, 1 h. 25 a.</td>
<td>69°</td>
<td>58°</td>
<td>57°</td>
<td>71.91</td>
<td>35.68</td>
<td>24</td>
<td>0.3198</td>
<td></td>
</tr>
<tr>
<td>12, 10 h. 15 m.</td>
<td>57°</td>
<td>57°</td>
<td>57°</td>
<td>116.75</td>
<td>44.83</td>
<td>22.40</td>
<td>0.2176</td>
<td></td>
</tr>
<tr>
<td>13, 9 h. 50 m.</td>
<td>79°</td>
<td>58°</td>
<td>57°</td>
<td>140.33</td>
<td>53.58</td>
<td>29.60</td>
<td>0.2133</td>
<td></td>
</tr>
<tr>
<td>14, 11 h. 20 m.</td>
<td>59°</td>
<td>58°</td>
<td>58°</td>
<td>165.81</td>
<td>55.50</td>
<td>31.70</td>
<td>0.1610</td>
<td></td>
</tr>
<tr>
<td>15, 11 h. 40 m.</td>
<td>60°</td>
<td>58°</td>
<td>60°</td>
<td>190.83</td>
<td>24.50</td>
<td>39.70</td>
<td>0.1403</td>
<td></td>
</tr>
<tr>
<td>16, 11 h. 15 m.</td>
<td>75°</td>
<td>57°</td>
<td>55°</td>
<td>218.75</td>
<td>32.41</td>
<td>7.18</td>
<td>0.1270</td>
<td></td>
</tr>
<tr>
<td>15, 10 h. 00 m.</td>
<td>59°</td>
<td>56°</td>
<td>59°</td>
<td>281.50</td>
<td>70.75</td>
<td>27.30</td>
<td>0.0960</td>
<td></td>
</tr>
<tr>
<td>20, 9 h. 30 m.</td>
<td>67°</td>
<td>65°</td>
<td>65°</td>
<td>309.84</td>
<td>28.50</td>
<td>30.00</td>
<td>0.0890</td>
<td></td>
</tr>
<tr>
<td>22, 9 h. 30 m.</td>
<td>68°</td>
<td>66°</td>
<td>66°</td>
<td>309.84</td>
<td>28.50</td>
<td>30.00</td>
<td>0.0890</td>
<td></td>
</tr>
<tr>
<td>22, 10 h. 00 m.</td>
<td>68°</td>
<td>68°</td>
<td>61°</td>
<td>327.50</td>
<td>20.16</td>
<td>27.05</td>
<td>0.0782</td>
<td></td>
</tr>
<tr>
<td>24, 10 h. 25 m.</td>
<td>70°</td>
<td>69°</td>
<td>65°</td>
<td>381.08</td>
<td>28.58</td>
<td>28.40</td>
<td>0.0735</td>
<td></td>
</tr>
<tr>
<td>24, 10 h. 35 m.</td>
<td>66°</td>
<td>66°</td>
<td>58°</td>
<td>404.91</td>
<td>25.83</td>
<td>26.10</td>
<td>0.0686</td>
<td></td>
</tr>
</tbody>
</table>

II SERIES. Angular inclination = -15° 25' |
| 26, 5 h. 20 a. | 63° | 65° | 62° | 450.83 | 36.91 | 30.2 | 0.0657 |
| 28, 0 h. 30 a. | 66° | 66° | 55° | 502.33 | 43.50 | 30.45 | 0.0685 |

III SERIES. Angular inclination = -2° 7' |
| Mar. 1, 10 h. 50 m. | 51° | 51° | 56° | 555.33 | 21.50 | 31.8 | 0.0685 |
| 2, 0 h. 30 a. | 56° | 56° | 56° | 555.33 | 21.50 | 31.8 | 0.0685 |

LIGHT-HOUSE PAPERS.
The captions to the foregoing table are supposed to be distinct enough to explain themselves. The range of temperatures there shown is so restricted as to be probably without material influence on the fluidity; at all events, the measure of such influence is so obscure that the temperatures themselves have merely been recorded for future reference and possible use hereafter.

The columns of distance run, unreduced for temperature, afford at once a visible contrast in both of what may be called the permanent and local fluidities of the different oils. This distinction will be recognized in comparing the last observation in the first series as between lard and sperm _34_. With the former the advance during nearly twenty-four hours was 0.1 inch, and double that of the latter; but during the next interval, when the force of gravity was increased, the greater permanent fluidity of the sperm _34_ is recognized by a run of more than 10 inches, while the lard advances little more than 2. But without attending to this distinction further, the number in the columns referred to, in any of the observations, furnish at once relative values for the general fluidity of the different samples. Thus, taking the last observation in each of the three series, we derive readily the following ratios of fluidity as under:

<table>
<thead>
<tr>
<th></th>
<th>Sperm <em>34</em></th>
<th>Sperm <em>40</em></th>
<th>H <em>40</em></th>
<th>H.</th>
<th>Lard.</th>
<th>Whale.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st series—ratio</td>
<td>1.—</td>
<td>1.01</td>
<td>0.94</td>
<td>0.96</td>
<td>0.86</td>
<td>0.88</td>
</tr>
<tr>
<td>2nd series—ratio</td>
<td>1.—</td>
<td>1.01</td>
<td>0.74</td>
<td>0.70</td>
<td>0.67</td>
<td>0.64</td>
</tr>
<tr>
<td>3rd series—ratio</td>
<td>1.—</td>
<td>0.99</td>
<td>0.54</td>
<td>0.49</td>
<td>0.49</td>
<td>0.44</td>
</tr>
</tbody>
</table>

The adjacent columns, however, of velocities per hour furnish a more comprehensive ratio than those which are to be derived from the different series separately; indeed, it was in view of such an application that more than one series was observed. The columns in question contain numbers in a converging series, whose apparent want of regularity chiefly arises from the want of equidifference in the epochs of observation. When the series is interpolated so as present values of velocity corresponding to equal intervals of time, this irregularity in a great measure disappears, second differences become nearly constant, and the value corresponding to any observed time may be reproduced with tolerable accuracy from any three equidistant terms taken as the first in the series.

In point of fact, however, and in view of the labor demanded for such a double interpolation, it is near enough for the present purpose to rehabilitate any required term by taking proportional parts of the difference between the two observed terms immediately preceding it, and it is in this way that the results presently given have been calculated. But, however calculated, it is manifest that if series I be continued by interpolation to the epoch of the first term of series II, we shall have a value for velocity smaller than that actual first term; and the difference between the observed term, which belongs to a greater inclination of the plate, and the calculated term, which represents what would have been observed had the inclination remained unchanged, indi-
icates the effect produced by gravity. Of course, in this case, gravity is in fact encumbered with the friction and inspissation of the oils, respectively; but looking no further for the moment than to series II, the first of these affections (friction) is always constant, and the second, (inspissation,) which depends upon the oxidation, and possibly other chemical changes in the oils exposed, and so may vary in the different samples, may be considered so slightly variant as to be assumed to be constant also; and thus the differences obtained may be attributed to gravity solely, and regarded as indices of the fluidity of the masses respectively.

The numerical values of the differences thus obtained are as under:

<table>
<thead>
<tr>
<th>Sperm. 34</th>
<th>Sperm. 40</th>
<th>H. 40</th>
<th>H.</th>
<th>Lard.</th>
<th>Whale.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity observed</td>
<td>0.0928</td>
<td>0.0928</td>
<td>0.0712</td>
<td>0.0687</td>
<td>0.0657</td>
</tr>
<tr>
<td>Velocity calculated</td>
<td>0.0643</td>
<td>0.0652</td>
<td>0.0608</td>
<td>0.0613</td>
<td>0.0606</td>
</tr>
<tr>
<td>Differences</td>
<td>0.0285</td>
<td>0.0276</td>
<td>0.0104</td>
<td>0.0074</td>
<td>0.0051</td>
</tr>
</tbody>
</table>

These differences show the influences which gravity has had in argumenting velocities, and in so far are relative measures of the characteristic (fluidity) which we are engaged in comparing.

Another set of relative measures of the same characteristic can be obtained from the observations in series III, by applying to them the same process which has just now been explained. Of this application the numerical results are as under:

<table>
<thead>
<tr>
<th>Sperm. 34</th>
<th>Sperm. 40</th>
<th>H. 40</th>
<th>H.</th>
<th>Lard.</th>
<th>Whale.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity observed</td>
<td>0.1164</td>
<td>0.0661</td>
<td>0.0606</td>
<td>0.0605</td>
<td>0.0551</td>
</tr>
<tr>
<td>Velocity calculated</td>
<td>0.0857</td>
<td>0.0628</td>
<td>0.0543</td>
<td>0.0534</td>
<td>0.0496</td>
</tr>
<tr>
<td>Differences</td>
<td>0.0307</td>
<td>0.0133</td>
<td>0.0063</td>
<td>0.0081</td>
<td>0.0055</td>
</tr>
</tbody>
</table>

The observation of sperm 40 was, in this series, accidentally missed. The order of other samples is the same here as in the former case, except the H., which, in falling below lard, seems to have been subject to some local irregularity of the apparatus or accidental alteration of its own constitution, of no great amount, but sufficient to exclude it from the comparisons that are going to be made of the others.

Now had these last differences resulted in the same numerical value as the former ones, it would have shown that the influence of gravity, which is theoretically equal in both cases, was actually equal in both, and that there had been no agency at work to augment or diminish that influence. Conversely, as the numerical values are different, it shows that there has been some alteration in the effect of gravity; and, the number operated upon being a converging series and to be taken with contrary signs, the higher values in the second instance show that the
action has been diminished, and diminished to the extent of the difference between the two sets of values. The cause of this diminution is, of course, in the gradual inspissation of the oils; which, in the previous calculations, has been assumed as constant for all the samples, but which, it will be seen, now varies for each and finds an index in terms of velocity by subtracting the last set of differences from the former. The following is the numerical result of the subtraction as well as the ratio of the indices in question:

<table>
<thead>
<tr>
<th></th>
<th>Sperm. 34</th>
<th>Sperm. 40</th>
<th>H. 40</th>
<th>H.</th>
<th>Lard.</th>
<th>Whale.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index of inspissation . . .</td>
<td>-0.022</td>
<td>May be taken as equivalent to the preceding.</td>
<td>-0.0029</td>
<td>May be taken as equivalent to the preceding.</td>
<td>-0.0030</td>
<td>-0.0036</td>
</tr>
<tr>
<td>Ratio of fluidity . . .</td>
<td>1.</td>
<td>. . .</td>
<td>0.76</td>
<td>. . .</td>
<td>0.73</td>
<td>0.61</td>
</tr>
</tbody>
</table>

The ratio of these negative indices of inspissation, taken reciprocally positive, has here been called the ratio of fluidity; because practically, in all applications of oil requiring exposure to the air and contact with metals, (which covers nearly or quite all the uses of oils of the class now in question,) the act of thickening or inspissation is the reciprocal of fluidity. To determine absolute fluidities, i.e. the force of cohesion (or rather the want of cohesion) of the particles, would require a special apparatus and much attention; while, after all, such a determination would only apply in the abstract or momentarily to the particular liquid at the epoch of its being observed, and, to be made practically useful, would have to be taken in connection with the age and previous exposure of the liquid, and of its tendency to inspissate under general or special circumstances—the very topic of the present research and determination.

The absence of tendency to thicken appears of great importance in the application of oils to the purpose of illumination, quite as much or more, indeed, than in other applications to which it is generally considered as more directly interesting, such as, for instance, the lubrication of machinery; and it is for this reason that the characteristic tendencies in this respect of the different samples have been observed and discussed here so much at length.

5. Affection by heat.—Expansion.—The experiments on expansion were made in the following manner:

A glass bolt head, capable of holding about 10 ounces weight of oil, and divided along its stem directly to thousandth parts of its capacity, (which division had been made for another purpose very carefully,) was filled, as nearly as convenient, to its zero point, with oil of the sample under trial; and was then suitably suspended in a metal vessel holding about two and a half gallons of water. A thermometer was similarly suspended close alongside and with its bulb at the same depth with the centre of the bolt-head bulb. The water was then heated to near its
boiling point, the vessel and apparatus removed to a separate chamber, and, after an average interval of three-quarters of an hour, which was presumed sufficient to allow of equilibrium of temperature being established between the oil and the water enveloping it, the stand of the mercury in the thermometer and of the oil in the bolt-head stem (which became, in fact, a large oil thermometer) was begun, and, at convenient intervals throughout the day, continued to be observed and recorded. The cooling of the large mass of water was so slow that a whole day was required for each sample, and the more the cooling progressed, until the temperature approached that of the chamber itself, the more marked became the differences of temperature at different depths in the boiler. To read the thermometer, therefore, without lifting it, (which was not always easy to be done,) was the only precaution that had to be taken in this respect. The stand of the oil, on the contrary, altered very slowly, and the graduation for that could be very carefully and patiently examined. The thousandths marked on this scale cover each a space of rather more than \(\frac{1}{4}\) of an inch, and admitted therefore of ten thousandths being estimated with tolerable precision. Perhaps it would be more just to say that five thousandths could be thus estimated; which is as near as an apparatus of this sort can be relied on with certainty. This is by no means an approximation sufficient to determine for theoretical purposes a physical constant, not being, at best, accurate beyond the fourth decimal place; while the stathmometric method, applied already by one of us to the determination of the expansion of linseed oil, measures readily and exactly up to the seventh decimal. But the method employed here was ample for the present aim; and was besides the only one, if any were admitted at all, that could be expected to come into use in ordinary hands as a practical test among oils.

The following are the results of the four samples, which were all it was thought necessary to observe, and in the order in which the experiments were made:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>46°</td>
<td>1.0015</td>
<td>1.001500</td>
<td>125°</td>
<td>1.0351</td>
<td>1.034917</td>
</tr>
<tr>
<td>51°</td>
<td>1.0036</td>
<td>1.003615</td>
<td>135°</td>
<td>1.0390</td>
<td>1.039147</td>
</tr>
<tr>
<td>66°</td>
<td>1.0099</td>
<td>1.009960</td>
<td>145°</td>
<td>1.0436</td>
<td>1.043377</td>
</tr>
<tr>
<td>74°</td>
<td>1.0133</td>
<td>1.013344</td>
<td>155°</td>
<td>1.0480</td>
<td>1.047067</td>
</tr>
<tr>
<td>105°</td>
<td>1.0285</td>
<td>1.028457</td>
<td>165°.5</td>
<td>1.0522</td>
<td>1.052949</td>
</tr>
</tbody>
</table>

Expansion of Sperm Oil.
### Expansion of Lard Oil

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>47°</td>
<td>1.0075</td>
<td>1.007500</td>
<td>110°</td>
<td>1.0340</td>
<td>1.034149</td>
</tr>
<tr>
<td>70°</td>
<td>1.0171</td>
<td>1.017299</td>
<td>115°</td>
<td>1.0374</td>
<td>1.037533</td>
</tr>
<tr>
<td>75°</td>
<td>1.0192</td>
<td>1.019344</td>
<td>130°</td>
<td>1.0465</td>
<td>1.046416</td>
</tr>
<tr>
<td>90°</td>
<td>1.0256</td>
<td>1.025689</td>
<td>140°</td>
<td>1.0493</td>
<td>1.048954</td>
</tr>
<tr>
<td>100°</td>
<td>1.0299</td>
<td>1.029919</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Expansion of H. Oil

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>60°</td>
<td>1.0191</td>
<td>1.019100</td>
<td>130°</td>
<td>1.0485</td>
<td>1.048710</td>
</tr>
<tr>
<td>80°</td>
<td>1.0275</td>
<td>1.027560</td>
<td>140°</td>
<td>1.0529</td>
<td>1.052540</td>
</tr>
<tr>
<td>90°</td>
<td>1.0317</td>
<td>1.031730</td>
<td>145°</td>
<td>1.0542</td>
<td>1.054209</td>
</tr>
<tr>
<td>97°</td>
<td>1.0343</td>
<td>1.034751</td>
<td>160°</td>
<td>1.0634</td>
<td>1.063515</td>
</tr>
<tr>
<td>108°</td>
<td>1.0391</td>
<td>1.039404</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Expansion of Whale Oil

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
<th>Temperature</th>
<th>Expansion observed</th>
<th>Expansion calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>61°</td>
<td>1.0155</td>
<td>1.015500</td>
<td>99°</td>
<td>1.0318</td>
<td>1.031576</td>
</tr>
<tr>
<td>65°</td>
<td>1.0177</td>
<td>1.017615</td>
<td>105°</td>
<td>1.0342</td>
<td>1.034114</td>
</tr>
<tr>
<td>85°</td>
<td>1.0258</td>
<td>1.025654</td>
<td>120°</td>
<td>1.0443</td>
<td>1.044268</td>
</tr>
</tbody>
</table>

The columns of calculated expansions affixed to these observations have been throughout founded upon one and the same factor, viz: 0.000423 per degree of Fahrenheit, derived at first from the sperm series—being the average, very nearly, of all the readings there. Had this factor been carried to a more remote decimal and used, it would have given results more strikingly accordant in the sperm and whale series, but more in excess for the lard and H. samples. It was not, however, a compromise which dictated its employment; but the convic-
tion that it was sufficiently exact to illustrate the conclusion which all the observations warrant, viz: that although these different oils have not precisely the same factor of expansion, yet the difference between their respective factors is very minute and not readily appreciable by any practical test, so as to establish a marked distinction among them.

Cooling and Solidification.

Experiments on these characteristics were thus made: Samples of the different oils were put in spherical glass flasks of the same size and filled to exactly the same volume, viz: two fluid ounces. The flasks were then immersed in a vessel of water (so wide as to allow of their contents being clearly visible all the time) which was itself set in another vessel containing the cooling mixture. Thermometers were kept in the water-bath, as well as in one or other of the flasks, until the water congealed; when the frigorific mixture was applied directly to the flasks in the bath itself. The temperatures here recorded are those of the thermometers in the oil only; the temperature of the bath being uniformly from 2°.5 to 3° lower.

The thermometer stand was noted at the first sign of congelation; which, in some of the instances, was a milky or rather tallow-like ring, commencing to form against the sides of the flask and progressing towards the centre, and in others was a somewhat iridescent, milky pellicle, that spread itself with a certain suddenness over the entire surface of the oil in the flask. After this, the refrigeration was urged until the entire masses respectively became gelatinized or quite solid. The following table exhibits the results:

<table>
<thead>
<tr>
<th>Temp</th>
<th>H.</th>
<th>H40</th>
<th>Sperm40</th>
<th>Whale</th>
<th>Lard</th>
<th>Sperm34</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°.5</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40°</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39°</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td>Pellicled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37°</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td>Pellicled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35°</td>
<td>Milky ring</td>
<td>Milky ring</td>
<td>Pellicled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30°</td>
<td>Congealed</td>
<td>Congealed; white deposit.</td>
<td>Congealed; part solid.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28°</td>
<td>Congealed; part solid.</td>
<td>Congealed; part solid.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17°</td>
<td>Gelatinous</td>
<td>Congealed; part solid.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14°</td>
<td>Gelatinizing</td>
<td>Congealed; part solid.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is here termed congelation, in the case of the two sperm oils, seemed to be not properly a solidification of the mass but a deposit of a substance resembling spermaceti, much the most copious in the winter sperm, the supernatant liquid appearing unaltered. It was of no practical interest in these, or the other cases, to prolong the experiment down to total solidification, for the deterioration of the sample for purposes of illumination was evidenced long before, and at the time of the formation of the ring or pellicle first noticed.
6. Combustion.—Experiments for this were made with ordinary-tinned jacket lamps, as nearly as might be of the same capacity and same-sized wick-holder, which were filled to the same level with what proved to be very nearly the same weight of the oils, respectively, and provided with wicks, untwisted, of the same number (30) of strands, carefully cut to the same length and set to the same height; in short, with all the arrangements and circumstances, the same for each. They were then lit, left to burn undisturbed for a certain time, extinguished simultaneously, weighed (as they had been before lighting) to determine the consumption, relit, and so on, through three series of observations, of which the following table gives all the necessary results:

<table>
<thead>
<tr>
<th>Time in burning</th>
<th>Sperm 34 Gr. pr. min.</th>
<th>Sperm 40 Gr. pr. min.</th>
<th>Lard Gr. pr. min.</th>
<th>H 40 Gr. pr. min.</th>
<th>H Gr. pr. min.</th>
<th>Whale Gr. pr. min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 minutes</td>
<td>1.7908</td>
<td>1.3974</td>
<td>1.3686</td>
<td>1.3265</td>
<td>1.3215</td>
<td>1.3054</td>
</tr>
<tr>
<td>290 minutes</td>
<td>1.7814</td>
<td>1.3725</td>
<td>1.3816</td>
<td>1.3571</td>
<td>1.4126</td>
<td>1.3292</td>
</tr>
<tr>
<td>440 minutes</td>
<td>1.7013</td>
<td>1.3906</td>
<td>1.3194</td>
<td>1.3075</td>
<td>1.2019</td>
<td>1.2809</td>
</tr>
<tr>
<td>Ave. consumption.</td>
<td>1.7908</td>
<td>1.3545</td>
<td>1.3485</td>
<td>1.3224</td>
<td>1.2087</td>
<td>1.3052</td>
</tr>
<tr>
<td>Ratio</td>
<td>1.00</td>
<td>0.78825</td>
<td>0.76956</td>
<td>0.75652</td>
<td>0.75756</td>
<td>0.74012</td>
</tr>
</tbody>
</table>

The rate of combustion being a function of the fluidity of the oil, is in a measure an index of fitness for purposes of illumination. In the foregoing table, it is seen that all the samples, except the whale and H 40, show a rate diminishing directly with the time in burning. These two only show in the second interval an increased rate. This apparent anomaly arises, no doubt, from the state of the wick during combustion. Thus the observations applicable to the whole period of burning were, that—

Lard oil in combustion leaves a jagged, irregular wick, with frequent points here and there remaining at a red heat.

Whale oil gives rise to remarkable fungose, sometimes bonnet-shaped processes of unconsumed carbon, which, as they are growing, render dim, but when they fall off at intervals, spontaneously or otherwise, refresh, the light.

Sperm oil, both winter and summer, burns with a clean, even wick, pointed here and there in white.

H. oil exhibits the same phenomenon as whale, only not quite so abundantly.

H 40 burns with a wick like the other H., with the phenomenon of here and there, red points, like those observed with lard.

These bonnets of unconsumed carbon, which are peculiar in their excess to the samples of whale and H., and visibly affect the regularity of illumination, affect, no doubt, with similar irregularity the rate of combustion, and thus in some degree account for the anomalies of the table.

The state to which the wick is reduced by combustion in it of the different samples, is further indicated by the relative facility in relighting after extinction, upon which the following observations were made:
Order of facility:—First relighting. Second relighting.

Sperm 34. No. 1. Lights instantly.
Sperm 40. No. 2. Lights very easily.
Hard. No. 3. Lights easily.
H. No. 4. Lights hardly.
H 40. No. 5. Lights very hard.

A numerical index of the degree of coaling of the wick, evidenced for the different samples respectively in the last two classes of observation, cannot be derived from them at all; but some approximate values may be obtained by comparison of the rates of combustion before given. This can only be done in four of the cases; the remaining two (whale and H 40) have been already noted as anomalous, and are too irregular for calculation.

It is true that, in general, the diminishing rate of combustion is attributable in part to the diminishing supply of oil in consequence of the lowering of the surface of the reservoir and the increased labor of the capillary fibres, as well as to the carbonized and more impervious state of the wick. But the effect of the first of these causes cannot be very material in the present instance; and we may therefore, for approximation, consider the successive diminutions as arising from the condition of the wick, and compare and proportion them accordingly.

If, then, the amount of coaling and deterioration of the wick were the same with all the samples, the proportion of the differences of consumption in the two intervals of the three observations would be constant for all; and, of course, if the amount of coaling varies in the several samples, the said proportion will vary directly with it, and thus serve to indicate the varying amount.

Now, in fact, for the four calculable cases, the differences in question and their proportion are as under:

<table>
<thead>
<tr>
<th>Differences of consumption in grains per minute</th>
<th>Sperm 34</th>
<th>Sperm 40</th>
<th>H</th>
<th>Lard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion</td>
<td>0.0184 : 0.0611</td>
<td>0.0149 : 0.0689</td>
<td>0.0889 : 0.0507</td>
<td>0.0970 : 0.0482</td>
</tr>
<tr>
<td>1 : 4.4</td>
<td>1 : 4.6</td>
<td>1 : 5.7</td>
<td>1 : 6.6</td>
<td></td>
</tr>
</tbody>
</table>

Relative coaling of wicks

1
1.05
1.30
1.50

Such are the approximations of their characteristic, which will be referred to again presently.

7. Illuminative power.—The experiments on this were made with a Ritchie photometer, in which the rays from a standard light and from that under comparison, at opposite ends of a long box, are caught upon two equal and similar mirrors placed within, back to back, at angles of 45°, and thus reflected vertically upwards through a suitable opening over the junction of the mirrors, where they are tempered by passing through a screen of uniform tissue paper. Of course, the squares of the distances of the two lights from the junction of the mirrors, when the screens are equally illuminated, represent the relative intensities of the
light. The standard employed was a candle of Judd's patent sperin sixes, which burn with great uniformity and are very proper for such an application. The oils were burned in the lamps with the wicks and precautions already described. The lamps were lit at three-quarters past six o'clock, on the morning of the 12th of February; four hours afterwards the experiments were commenced; an hour and a half was required for their completion; so that the mean time of burning was nearly five hours, which was fixed upon as a fair average period for developing the properties of the combustibles, both in respect to illumination and to their modes of combustion. As far as the lard oil, however, is concerned, this period was undoubtedly too prolonged; for its wick had become so jagged and crusted, and its light so dim, that, except for form's sake, it was wholly unfit to be introduced into the comparison. It should be said that none of the wicks had been touched or disturbed during the whole period.

After one set of experiments had been gone through with, the photometer was turned end for end, and another set performed—not so much for confirmation's sake, or as a test of the instrument which had been before ascertained to be tolerably reliable, but for the purpose of a special comparison, which will be spoken of hereafter. In comparing the intensities of the light, the homologous terms of the two sets were multiplied together for an average ratio, instead of squaring the terms of each set separately and averaging between them. The arithmetical division of these products, respectively, gives the value of the respective lamp flames in terms of the standard candle light, as shown in the fifth column of the following table:

<table>
<thead>
<tr>
<th>OILS</th>
<th>PHOTOMETRIC DISTANCES</th>
<th>PHOTOMETRIC DISTANCES</th>
<th>Lamp in candle</th>
<th>Ratio of intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spern 34</td>
<td>9.875</td>
<td>10.75</td>
<td>8.2</td>
<td>10.75</td>
</tr>
<tr>
<td>Spern 40</td>
<td>9.0</td>
<td>10.75</td>
<td>7.25</td>
<td>10.75</td>
</tr>
<tr>
<td>H 40</td>
<td>5.8125</td>
<td>10.75</td>
<td>6.0</td>
<td>12.4975</td>
</tr>
<tr>
<td>H 9375</td>
<td>5.9375</td>
<td>10.75</td>
<td>5.75</td>
<td>12.50</td>
</tr>
<tr>
<td>Whale</td>
<td>6.0</td>
<td>17.5625</td>
<td>6.0</td>
<td>20.375</td>
</tr>
<tr>
<td>Lard oil</td>
<td>6.0</td>
<td>28.75</td>
<td>6.0</td>
<td>40.20</td>
</tr>
</tbody>
</table>

The last column of the preceding table gives merely the ratio of the intensities of the light of the several lamp flames, respectively, without reference to the quantity of oil consumed uniformly in maintaining the flames and producing their light. It is obvious that upon this quantity depends the economical applicability of the respective samples, or what may be called their specific illuminative power, which is directly, as the intensities themselves, and, inversely, as the quantities consumed in a given time.

Reducing, then, these intensities in the ratio of average consumption,
respectively, as given in a previous table, we obtain a final result, as under:

<table>
<thead>
<tr>
<th>Oils</th>
<th>Photometric ratio</th>
<th>Average ratio of consumption (p.)</th>
<th>Economical ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm</td>
<td>1. —</td>
<td>1. —</td>
<td>1. —</td>
</tr>
<tr>
<td>Sperm</td>
<td>0.8658</td>
<td>0.76925</td>
<td>1.04750</td>
</tr>
<tr>
<td>H40</td>
<td>0.3723</td>
<td>0.75102</td>
<td>0.4575</td>
</tr>
<tr>
<td>H32</td>
<td>0.3373</td>
<td>0.73756</td>
<td>0.4573</td>
</tr>
<tr>
<td>Whale</td>
<td>0.1336</td>
<td>0.74012</td>
<td>0.1865</td>
</tr>
<tr>
<td>Lard oil</td>
<td>0.0306</td>
<td>0.76585</td>
<td>0.0400</td>
</tr>
</tbody>
</table>

It is to be observed, upon the results of this table and the preceding, that while, other things being equal, the illuminative power is directly in the ratio of the consumption, yet circumstances, in being changed and unequal, may so modify the character of the combustion as, with an equal or even greater consumption of oil, to yield less light. Thus, the consumption of lard oil is nearly as great as that of summer sperm, and of whale oil greater than that of the H. sample; while the ratio of the light given in the respective cases is vastly disparate.

The probable explanation of such instances is to be found partly in the peculiar condition of the wick, which, itself carbonizing in such manner as not to offer a mechanical obstacle to the supply of the oil near its surface, yet presents it to or shields it from oxidation, by modifications of temperature or otherwise, in such a way as to allow the carbon of the oil to be burned without becoming highly luminous. It would be interesting, in a practical point of view, to have this topic investigated more fully.

But, without attempting to pursue is much further here, a comparison of the photometric distances just now given will serve to illustrate the subject. The contrast of different conditions of wick in the different samples, which was made in the last section, was founded upon the mechanical aspect only of interference with the capillary supply of the combustible. The difference of the distances just now mentioned, shows that the peculiar carboning of the wick, in the case of lard oil especially, affects the light in a different mode. This will be observable in the following table:

<table>
<thead>
<tr>
<th>OILS</th>
<th>First series.</th>
<th>Second series.</th>
<th>Difference of ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm</td>
<td>1</td>
<td>1.0888</td>
<td>1</td>
</tr>
<tr>
<td>Sperm</td>
<td>1</td>
<td>1.1944</td>
<td>1</td>
</tr>
<tr>
<td>H40</td>
<td>1</td>
<td>1.7204</td>
<td>1</td>
</tr>
<tr>
<td>H32</td>
<td>1</td>
<td>1.8105</td>
<td>1</td>
</tr>
<tr>
<td>Whale</td>
<td>1</td>
<td>2.9271</td>
<td>1</td>
</tr>
<tr>
<td>Lard oil</td>
<td>1</td>
<td>6.4583</td>
<td>1</td>
</tr>
</tbody>
</table>
Of course, if during any given period of burning, the condition of the wick is unaltered, the ratio of the photometric distances at the beginning and end of such period will be unchanged. Also, with the same wick, if the same combustible be used, although the ratios at the beginning and at the end will vary, their differences will be constant and in the same sense. And when with different combustibles and the same wick the differences are irregular, it seems that it would be possible, by proper observations, to assign to each element its proper share in the result and to determine how much of the irregularity is due to deterioration in the supplying power of the wick, and how much to the peculiar affection of the individual combustible in being burnt.

Of course, also, in this determination, the chemical constitution of the combustible, which, in what has been so far said, has been considered as unascertained, plays a part more or less important, according to the proportion of carbon and residual hydrogen which the sample may contain. But this topic will come up more suitably in the succeeding portion of the memoir, which concerns—

CHEMICAL CONSTITUTION OR INTERNAL PROPERTIES.

1. Homalism.—Among these was first examined the homalic state of the different samples, i. e., the presence or absence of any uncombined acid or alkali, as evidenced by indifference to test-paper stained with litmus and immersed in them.

None of the samples gave any reaction upon such a test, either immediately or within an hour and a half. Observed again after twenty-four hours, the two samples of sperm manifested a very faint acid action, which was less marked in sperm than in the other. The remaining samples, after this long exposure, were still absolutely neutral.

But when they were boiled in a long test-tube, at the mouth of which slips of test-paper were suspended in the vapor, there occurred a very slight acid reaction in all the samples, showing that the temperature of boiling oil (about 600° F.) is sufficient to overcome the normal affinities in the substance and liberate some undetermined acid which ordinarily remains combined.

2. Qualitative associations.—A general examination was made for the detection of acids and basis that might exist in any of the samples, and especially in the presumed factitious ones of H.

There were found very slight traces of chlorine in all, and similarly slight traces of potassic in all, except the lard oil. Such traces do not allow of any comparative scale or estimate of quantities as probably existing in the respective samples, and fail, therefore, to lead immediately to any instructive result in the way of furnishing means for determining either the fact or the extent of adulteration.

3. Quantitative composition.—Nor was such instruction expected to be found directly in the determination, by organic analysis, of the proportions of ultimate elements constituting the different oils, which, however,
with a special view that will be referred to more particularly hereafter, was made for the three natural oils, and resulted as under:

<table>
<thead>
<tr>
<th>Ultimate elements</th>
<th>Lard oil</th>
<th>Whale oil</th>
<th>Sperm oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.76658</td>
<td>0.77511</td>
<td>0.76490</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>0.10586</td>
<td>0.11430</td>
<td>0.12150</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.12756</td>
<td>0.11059</td>
<td>0.11360</td>
</tr>
<tr>
<td>Residual hydrogen</td>
<td>0.089015</td>
<td>0.100476</td>
<td>0.107300</td>
</tr>
</tbody>
</table>

These analyses were not extended to the summer sperm or to the H. samples, partly on account of the tediousness and costliness of the operation, but chiefly because the differences between the extremes of any one of the elements in the ascertained cases were so small as not to yield directly to any decisive result.

Before leaving this point of investigation, however, it was of course desirable to ascertain how far the numerical results of the analyses were reliable, and to determine their probable limits of error for the content of carbon, at least, which element presents the chief difficulty of accurate elimination. As for the hydrogen, there is so much less likelihood, both in theory and in fact, of its apparent quantity being affected by the accidental errors of the process, that such apparent quantity may safely be taken for the true one.

This being assumed, the ascertained specific gravities furnish a scale whereby the probable errors in the quantity of carbon may be assigned. In applying this, the apparent quantities of the several elements, expressed in proportionate weights, were reduced to volumes, and the factor of contraction in bulk from the gaseous elements to the liquid oil, ascertained for each sample.

These volumes were all numerically different, as might be expected, standing, in fact, in the following ratio, viz:

\[
\begin{align*}
\text{Sperm}_34 & : \text{Whale} : \text{Lard} \\
1 & : 0.973 & 0.938
\end{align*}
\]

But when these came to be combined with the respective specific gravities of the several oils, in order to obtain the factors for contraction, the ratio of said factors was different, and stood actually as under:

\[
\begin{align*}
\text{Sperm}_34 & : \text{Whale} : \text{Lard} \\
1 & : 1.024 & 0.978
\end{align*}
\]

How far these differences connect themselves with the mode of combination of the several elements, and serve to indicate important differences of nature (so to speak) in different oils of nearly identical ingredients, would be an interesting research for general purposes; but it was not called for here, and the only use that has been made of the indications was to assume that the factor of contraction is constant for
all samples; that its apparent variations proceeded from errors of experiment, and that the average of all the variations would represent its true mean value. This mean value was applied to correct the original number of volumes, and the ratio of said original and the corrected number was taken as the ratio between the observed and the probable limiting quantity of carbon in the respective oils. The calculation of the quantities resulted as under:

<table>
<thead>
<tr>
<th></th>
<th>Sperm.</th>
<th>Whale.</th>
<th>Lard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon found</td>
<td>0.76490</td>
<td>0.77511</td>
<td>0.76558</td>
</tr>
<tr>
<td>Carbon calculated</td>
<td>0.76118</td>
<td>0.75554</td>
<td>0.75867</td>
</tr>
</tbody>
</table>

The differences between experiment and calculation, amounting to nearly 1/2 per cent. on the oil for whale and lard, and 3/4 per cent. for sperm, show that the probable content in carbon may vary according to circumstances for the three kinds of oil between the limits as under:

<table>
<thead>
<tr>
<th></th>
<th>Content in carbon.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum. — Minimum.</td>
</tr>
<tr>
<td>Lard oil</td>
<td>0.78367 — 0.74949</td>
</tr>
<tr>
<td>Whale</td>
<td>0.79168 — 0.75654</td>
</tr>
<tr>
<td>Sperm</td>
<td>0.76863 — 0.76118</td>
</tr>
</tbody>
</table>

Such are all the particulars that appear necessary to be stated here in reference to the item of chemical composition. What follows is the result of divers comparative tests, intended for fixing the relation to the natural oils of the (supposed) factitious H. samples.

4. Chromatic tests.—These are judged of, as the epithet implies, by the color struck in given masses of the oils, respectively, (contained, for instance, in a test-tube,) by given and equal volumes of different acid and alkaline reagents. The several reagents here employed were nitric and sulphuric acids and caustic soda in solution; which last was boiled in the test-tube with the oils. Aqua regia (nitro-muriatic acid) with soda was also applied; but it gave no instructive indications.

A good many preliminary experiments were tried, both with the several samples and also with mixtures of the different natural oils in various proportions, in order to determine the most advantageous strength of the acid reagents. It is not necessary to give the details of these: but it may be said that sulphuric acid of a density higher than 1.475, (as for example, of 1.53 and 1.635,) is too strong, carbonizing the mass so deeply as to destroy all characteristic grades of hue; while, on the other hand, nitric acid of density less than 1.22 failed to attack decidedly either the sperm or lard oils.

The following table gives the result of experiments, with the acids, &c., adopted upon all the samples. The mixtures were in definite volumes; and the unitary volume of acid employed (one fluid drachm) was
throughout constant. The volume of oil was likewise constant, and equal to five fluid drachms. The volume of soda only was ten fluid drachms. After the mixture was uniformly shaken, it was left to rest for five minutes, and the color, both of the oil above and of the acid substratum below, observed and noted. Although the hues of the upper and lower portion of the mass were different, yet their relations in the several samples were found to be always the same, except in one instance (with sulphuric acid) where the anomaly was so slight as to be insignificant. The sequence in the table is of hues darkening as they succeed.

<table>
<thead>
<tr>
<th>1 vol.</th>
<th>1 vol.</th>
<th>1 vol.</th>
<th>1 vol. nitric acid, (1.33.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulph acid, (1.47.)</td>
<td>Nitric acid, (1.22.)</td>
<td>Nitric acid, (1.33.)</td>
<td>10 vol. soda, (1.34.)</td>
</tr>
<tr>
<td>Sperm._34</td>
<td>Sperm._34</td>
<td>Sperm._34</td>
<td>Whale.</td>
</tr>
<tr>
<td>Whale.</td>
<td>H._40</td>
<td>H.</td>
<td>H.</td>
</tr>
<tr>
<td>H.</td>
<td>Sperm._40</td>
<td>H._40.</td>
<td>Sperm._24</td>
</tr>
<tr>
<td>Sperm._40</td>
<td>H.</td>
<td>Whale.</td>
<td>Sperm._40</td>
</tr>
</tbody>
</table>

The inference from these experiments, like that derived from all the preceding tests is, that H. samples are intermediate between sperm and whale oils, and are, therefore, probably a mixture of the two.

To test this inference more precisely, elaborate series of experiments were next made in a similar manner upon these H. samples, and upon the ten mixtures whose proportions are given on page 6, whose external properties, in general, strongly resemble more or less those of the H. samples, and whose specific gravities are respectively the same. These mixtures were, for greater distinctness and impartiality, numbered in the order in which they occur on the page already quoted, and were referred to and known only by their numbers.

It is not necessary for the present purpose to give the details of the experiments, which had to be made with great minuteness, and show the gradually darkening shades of the several samples throughout, as just now exhibited in the former group. It will be enough to present the main result of identity or near equality of color between the H. samples and some one or other of the mixtures with the various reagents, respectively, as follows, the volumes, &c., being as already mentioned:

1 volume sulphuric acid, sp. gr. 1.475 with 5 volumes oil:
After 3 days, \( H. = H._{40} = No. 1 = No. 3 \).

1 volume nitric acid, sp. gr. 1.33 with 5 volumes oil:
After 5 minutes, \( H. = No. 1 \).
After 3 days, \( H. = No. 1 = No. 3 \), nearly.
After 5 minutes, \( H._{40} = No. 10 \).
After 3 days, \( H._{40} = No. 9 = No. 6 \), nearly.

1 vol. nitric acid, sp. gr. 1.33, and 10 vols. soda, with 5 vols. oil.
After 40 hours, \( H. = No. 9 \), nearly.
After 40 hours, \( H._{40} = No. 3 \), nearly.
But the shades were so slightly marked in this series that the observations were recorded at the time as not conclusive:

1 volume soda, sp. gr. 1.34, with 5 volumes oil:
After 15 minutes, \( H = H_{40}^+ = \) No. 3.

After 3 days, \( H = H_{40}^+ = \) No. 1. = No. 3.

Neglecting those equations which are nearly approximate, the results may be more perspicuously grouped, as under:

<table>
<thead>
<tr>
<th>Sulph. acid</th>
<th>Nitr. acid immed.</th>
<th>Nitr. acid 3 days</th>
<th>Soda</th>
</tr>
</thead>
<tbody>
<tr>
<td>H ..........</td>
<td>No. 1 ..........</td>
<td>No. 1 ..........</td>
<td>No. 3</td>
</tr>
<tr>
<td>( H_{40} )</td>
<td>No. 3 ..........</td>
<td>No. 10 ..........</td>
<td>No. 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 9 ..........</td>
<td>No. 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 1 ..........</td>
<td>No. 3</td>
</tr>
</tbody>
</table>

With the first and the last of these reagents the two \( H \) samples were themselves but faintly distinguishable; and, as might have been expected, their differences are denoted by opposite signs. If we resort, then, to the specific gravities, and couple their indication with this last table, it may be concluded with tolerable certainty that the \( H \) sample is the same as No. 1, and that the \( H_{40} \) can only be No. 3, No. 9, or No. 10. If mixtures be made according to the formulæ of these numbers, they will be hardly distinguishable, by any of the tests hitherto known, from the \( H \) samples, respectively.

5. Thermal Tests.—An analogous result is secured by another kind of test, to be spoken of now. These tests should be, in theory, absolute; they are, however, in fact, only comparative. They repose upon the observation made sometime since for certain vegetable oils, but here, for the first time, applied to animal oils, viz.: that when definite quantities of oil and of sulphuric acid, of a certain density, are mixed, the mass exhibits a rise of temperature which is nearly uniform, both in its maximum and in its range, after a given short period, (two and a half or three minutes,) and is characteristic of the oils themselves, respectively.

After this had been observed, very numerous experiments were made to determine the proper density and quantity of the sulphuric acid to be used, in order to yield the greatest differences in the characteristic temperatures. In regard to the first of these points, acid of 66° Baumé at 60° Fahrenheit, corresponding to a tabular density of 1.767, was taken as the most advantageous; and in regard to the latter, the temperatures were found to rise regularly with the three natural oils, lards whale, and sperm, as the proportion of acid by volume was increased from one-twelfth to one-half of the oils, respectively. When this last proportion was reversed, so as to make the volume of acid twice that of the oil, the resulting temperatures were found to decrease.

When mixed in the proportion of 2 fluid ounces of oil to 1 of acid, the normal rise above the initial mean temperature of the mass was ascertained to be, in—

Lard oil, 78° Fahr. at a maximum, and 74° after 2½ minutes.
Sperm\( \text{a}_{\frac{3}{4}} \), 69°.5 Fahr. at a maximum, and 66° after 2½ minutes.
Whale, 128°.5 Fahr. at a maximum, and 120° after 2½ minutes.
Sperm 34, 66°.25 Fahr. at a maximum, and 63.5 after 2½ minutes.

These constants are the mean of several observations, the individual variations of which, for lard and sperm 34, were but a fraction of a degree of Fahr., and as the whale series reached in one instance three degrees. In this last, however, the greatest deviation from the adopted mean is but a degree and half. The observations after a given interval appeared less discordant, and would be preferable for use in this respect, were it not that in practice they complicate the experiment. Nevertheless, they are all to be looked on yet as provisional only.

Next, trials were made in a similar manner upon mixtures in various proportions of whale and sperm oils, to see if their characteristic temperatures were maintained in alligation, with the following results:

<table>
<thead>
<tr>
<th>Sperm 34</th>
<th>Whale</th>
<th>Maximum temp.</th>
<th>Whale</th>
<th>Sperm 34</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.975</td>
<td>0.025</td>
<td>68°.125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.950</td>
<td>0.050</td>
<td>69°.——</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.900</td>
<td>0.100</td>
<td>72°.25</td>
<td></td>
<td>0.047</td>
</tr>
<tr>
<td>0.750</td>
<td>0.250</td>
<td>81°.25</td>
<td></td>
<td>0.199</td>
</tr>
<tr>
<td>0.700</td>
<td>0.300</td>
<td>84°.25</td>
<td></td>
<td>0.250</td>
</tr>
<tr>
<td>0.500</td>
<td>0.500</td>
<td>92°.9</td>
<td></td>
<td>0.400</td>
</tr>
</tbody>
</table>

This table, the mean of many observations whose individual differences were within the margin before mentioned, fully sustains the principle of characteristic temperature preserved in alligation; although from some want of precaution in manipulation or defect in observation, or error in the characteristic constants employed, the actual and calculated results are not the same. Their differences are, however, regular; and it would not be difficult to construct an empirical formula from these observations, or to apply corrections by which these differences would disappear.

But without any such corrections, if the H. sample, whose average maximum rise of temperature is 107°, with a variation of 1°.5 between the highest and lowest observation, be calculated strictly, it results in the following proportions, viz: Whale, 0.639; sperm, 0.361. The proportions of the artificial sample No. 1, which is identical in specific gravity and the other tests already mentioned, are, whale, 0.763; sperm, 0.247. The smaller proportion of whale oil accused by the thermal test, would lower the specific gravity from 0.91005 to 0.90546. In the methods procured for a certain definite gravity, there cannot be so great an uncertainty as this; and, therefore, the whole or greater part of the error must lie in the preparation of the mixtures and the mode of observing the temperatures. So far, therefore, this test is merely confirmatory of the comparative results of the preceding without imparting much more absolute precision.

In the case of the H. 40 sample, however, it does somewhat more, by
showing that there must be a third ingredient in the mixture. The maximum rise of temperature with this sample, averaged, is but 89.10, with a variation of 2° between the highest and lowest reading. This temperature would correspond to a mixture of whale 0.367; sperm 0.633; having a specific gravity of 0.89503 instead of 0.91104 belonging to the H. 40 sample. There must have been, therefore, some ingredient which adds to the specific gravity while it reduces the rise of temperature. Now, lard oil, which has a thermal function of only 78° Fahr., while its specific gravity is greater than that of H. 40, answers to these conditions; and it becomes easy to determine among the mixtures, just now mentioned as analogous or identical with H. 40 in all the other tests, which it is that coincides or comes the nearest in this one. Of these, there are but two triple mixtures, No. 9 and No. 10, which need be considered. The former of these should have by calculation a thermotropic maximum, or, what may be called for convenience, an epitherm of 107°.5; the latter an epitherm of 97°.4 instead of 89°.1 actually observed in H. 40. The variation of this latter falls within the margin which there was just now occasion to observe in the trial mixtures of the table last given; and there is, therefore, reasonable probability for inferring, upon all the several tests, that the mixture No. 10 and the H. 40 sample are identical.

If any one should ask what would be the effect upon the other tests in throwing all the stress upon this one, calculation shows that a mixture containing one-half the volume of whale oil less than is in No. 10, and differing 0.00214 in specific gravity, would have an absolutely identical epitherm; while observation of the numerous arbitrary mixtures, tried in the course of this research, authorizes it to be said that the chromatic tests heretofore spoken of would not be seriously affected by the diminution in question.

There is, however, a chromatic test first suggested in the course of these experiments which would be very sensitive, not to the diminution in the whale oil, indeed, but to the consequent increased proportion of lard oil residing in the mixture. This increase is in the ratio of 0.421 to 0.533, or more than 11 per cent., while the test itself is sufficiently delicate to discriminate readily down to 5 per cent. of lard oil in a mixture whose ingredients are otherwise unchanged. It still remains to be determined, however, by a series of experiments, whether this test is specific for lard oil under all circumstances and with any mixtures. Under the assumption which generally holds good, that the adulterants of sperm oil are only whale and lard oils, it undoubtedly applies to the latter with convenience and precision. This test, then, distinguishes the substitute mixture now in question. (Consisting of 1 part lard oil + 0.5 whale + 0.375 sperm) both from No. 10 and from H. 40.

The theory of the thermal action, which has been just now spoken of, is obscure and does not explain the cause either of the differences in the initial rise of temperature or epitherm with the different oils, or of the differences in the successive epitherms of the same oil observed in the earlier epochs of the experiments, when the relative proportion of
acid used was small. These differences are evidenced in the following paradigm of the mean of several observations:

<table>
<thead>
<tr>
<th>Mixture by Volume</th>
<th>Mean Epitherm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lard oil</td>
</tr>
<tr>
<td>Oil. Acid.</td>
<td>(°C)</td>
</tr>
<tr>
<td>1 0.083</td>
<td>22.7</td>
</tr>
<tr>
<td>1 0.167</td>
<td>53.7</td>
</tr>
</tbody>
</table>

Passing this, however, and taking only the latter epochs of the experiments, under the assumption that the products of combination in the mixture are sulphurous acid, water, and varying hydro-carbons whose conditions are yet unascertained, successive epitherms may be calculated, with a tolerable approximation, on the hypothesis that they are respectively as the water produced, directly, and as the aggregate of the specific heats of the several products inversely.

The following shows the worth of such calculation:

<table>
<thead>
<tr>
<th>Whale Oil</th>
<th>Sperm.34</th>
<th>Lard Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated</td>
<td>Extremes observed</td>
<td>Calculated</td>
</tr>
<tr>
<td>113°.4</td>
<td>114°.9 — 116°.6</td>
<td>64°.4</td>
</tr>
<tr>
<td>121°.2</td>
<td>123°.9 — 124°.5</td>
<td>67°.9</td>
</tr>
<tr>
<td>134°.1</td>
<td>127° — 130°</td>
<td>71°</td>
</tr>
</tbody>
</table>

In respect to another point observed in these thermal tests, viz: the existence of a maximum rise of temperature corresponding to certain proportions of acid, the calculations indicate the reasonableness of this in showing that at or about the point taken for such maximum, the aggregate specific heat of the mixture, which practically increases in a higher ratio than the caloric liberated by the union of the oxygen and hydrogen, has become such as to compensate for the actual increase of caloric so liberated. Of course, the sensible temperature, under these conditions, becomes for a while nearly stationary, and then falls agreeably to observation.

It can hardly be doubted that further study of these analogies, and others which have not been mentioned, will furnish a clue to a definite and satisfactory theory, capable of supplying a perfect test for the distinction and determination of these natural oils in whatever combinations they may exist.

J. H. ALEXANDER.  
CAMPBELL MORFIT.

University of Maryland,  
Baltimore, June, 1855.
SECOND REPORT ON OILS.


THORNTON A. JENKINS, Esq., U. S. N.,

U. S. Light-house Board, &c.

BALTIMORE, October 15, 1855.

SIR: I have the honor to present the accompanying report of Professor Morfit, of the University of Maryland, and myself upon certain oils transmitted to me for examination early in the current year, by your direction, and upon some which came to hand for a similar purpose and in the same way, only recently. A sample of so-called corn-oil, which came among these last, having been, with your approval, withdrawn as being unnecessary to be examined. The report now sent in covers, with the former, all the samples of oil that have been at any time submitted to me.

The principles and methods of examination applied here have been the same with those adopted in the former report, as far as they go only, the motive and aim being here not precisely the same as on the former occasion, there has been a corresponding modification in the extent and character of the research. There, the object was chiefly, by minute comparison of small differences, to determine identities; here, it is rather to ascertain the salient points of distinction and the comparative practical values of samples professedly different; there, the problem was to find out the probable composition of certain specimens; now, it is to examine into the relative fitness of certain other specimens for the purposes to which they are sought to be applied I hope that you will recognize these distinctions as having been properly drawn, and the results, in the two cases, as being, respectively, appropriately obtained.

For all these present samples, then, the density, fluidity, both characteristic and at special low temperatures, the rate of combustion, the tendency to deteriorate the wick and the direct illuminative power of each, are all the points strictly necessary to be observed. Some of these even reciprocally involve the others. Thus, the tendency to deteriorate the wick is calculable from the rate of combustion; and with the divers unadulterated animal oils that I have tried, (and probably with all, as well as with unadulterated vegetable oils, compared as a separate class and upon their own scale,) the illuminating power marches at the same rate, but inversely, with deterioration of the wick, and any one of a class being taken as a standard, may be arithmetically deduced with tolerable approximation from it.

Yet care has to be taken that the experiments for the most of these be performed under like circumstances. A slight change of temperature, say 5° F., perceptibly affects the rate of combustion in such lamps as I used; and a small difference in the height of wick, which might be expected to produce a difference in illumination, is as well marked in the quantity consumed in a given time. The experiments, to be properly comparable, seem to require a height of wick appropriate to each sample and as great as possible just not to smoke. Also, I think I have found
that this height, not to affect the results, must be obtained by gradual movement in the same direction upwards; a wick once in contact with flame, even for a brief period, and then drawn down again into the tube, no longer performs its normal functions as a capillary pump. It happens sometimes, indeed very often, that a wick set to a certain height and smokeless for a while, begins afterwards to smoke. This will always be found to arise from some projecting fibre in the interior of the flame where the air has less access than else where. It is hardly necessary to say that the proper remedy, at least the one resorted to in the present instances, is to cut off such fibre or fibres and not to lower the wick. The tendency of a wick to smoke is ascertainable with reasonable precision in the beginning by holding over the flame, at a distance above it, a small sheet of clean metal by which the draught is dampened and its carbon-depositing tendencies multiplied. If this distance is considerable, say 12 or 15 inches, and yet carbon is deposited on the sheet, the lamp will be very apt to smoke spontaneously after the sheet has been withdrawn.

In connection with the rate of combustion, and specially the photometric results which are more or less dependent upon it, I must not fail to observe that the economical values that are given in the last table under the head of these results have no relation, as might possibly be inferred from the epithet used, to cost. They refer altogether to the quantities of combustible used, which are, for this term, equated throughout, so as to compare the effect of equal quantities in equal times. This equation is made upon the hypothesis that with the same oil the illumination is in proportion to the quantity consumed in a given time, the other circumstances being equal. Thus, if any oil, burning at the rate of one grain per minute, gives a certain amount of illumination, the same oil, with a flame produced by the burning of 1.5 grains per minute, will give half as much more light. In point of fact, all the other samples but two consumed less per minute than the sperm, and all their actually observed indices of illumination have to be and have been, therefore, raised to what they would have been had their quantities consumed been as great as that of the Robinson sperm. The actually observed index of illumination, on the other hand, of the samples, lunar and non-gelatinous lard oil, whose consumption was greater than that of the Robinson sperm, has to be and has been lessened just in the proportion of the respective consumptions.

It is in this way, then, that the physical merits, expressed in terms of light furnished by equal quantities in a given time of the respective samples, have been prepared to admit application of their commercial merits, expressed in terms of price of a given quantity, in order to a determination, whenever desirable, of the question of relative cheapness. For example, if the economical photometric value of any oil B is 50 per cent. of that of another oil A, whenever the price of B is one-half that of A, the two fluids are, for the purposes of mere naked illumination, equally cheap; if B is less than half-price, it is the cheaper, and so on. There are, of course, other considerations when, as is the case with lenticular lights, the illumination is not naked, but enclosed, which enter in and control the question of cheapness. But this question is not
among those referred to me, and I have been unconsciously led to saying as much as I have said upon it.

In respect to another topic connected with combustion—the deterioration of wick, various with different oils—the method that has been used for its numerical determination is new, and, in proportion to the accuracy with which the several dimensions are taken, reliable. In the present instances I must not be regarded as offering more than tolerably approximate results. In the aspect in which these present samples are regarded here, their chemical constitution is not of so much importance. No quantitative analysis, therefore, has been made of them, because I considered that the probable practicable advantage in having its results did not warrant the certain expense. The differences in the ultimate elements of the different samples could be but small, and, in all likelihood, would be hardly more instructive as to the mode of compounding the factitious oils than the qualitative examinations in that view which have been made. In a purely scientific and theoretical point of view it would be very interesting to have a full analysis of the seal and colza oils; but the use to be made of such a knowledge would be, for sometime to come, altogether general and abstract, and I could not allow myself, therefore, without a special authorization, to burden your appropriation with what could not yield a direct corresponding practical benefit.

It is possible that you may think it of interest hereafter to pursue the colza research, whose unexpected inferiority in all the samples submitted is visible throughout the experiments, and is yet to me, in the face of different results elsewhere, inexplicable. Should this be the case, I recommend that these samples and others, if there is any doubt of the genuineness of these, (in view of which it was principally that the report has stated the source and date of acquisition of the several samples,) should be tried in advance by other methods of burning, as mentioned in the report.

Finally, I refer to the discussion of thermal tests, with which the report closes, as containing an unpessed corroboration of the convenience and reliability of the particular test, by epitherms, which I before had the honor to recommend, being introduced into the system of inspection of your supplies. And I respectfully suggest now that if, upon consideration, you should be favorably disposed to such introduction, it would be serviceable to collect in advance as great a variety as can conveniently be procured from respectable dealers of reputed unadulterated sperm, (both winter and fall,) with a view to the determination of their respective densities, epitherms, and illuminative powers, in order to know the margin which actually exists in these respects between the best and worst specimens of the same natural, unadulterated article, and in order, besides, to ascertain, if possible, the relation which undoubtedly connects the phenomenon of the epitherm with the illuminative power of any particular sample.

At present, you are aware, the intended use of the epitherm is only to assure us of the identity of the whole of any lot with its sample. It is possible that, by the means which I have suggested, it may be susceptible of more extended and advantageous application.
In general, I am very slow in committing myself to any step which leads to trouble or expense. In the present case I do not apprehend there will be much of either, while the probable prospective results are of high importance. I have, therefore, no hesitation in mentioning them as I have done.

Submitting this, then, and the other accompanying recommendations to your consideration, I have the honor to remain, sir, your obedient servant,

J. H. ALEXANDER.

REPORT.

The oils to be spoken of in the following report, were from samples submitted at different times and examined at various periods. The particulars of name, date of receipt, and number affixed to each, necessary for distinctness and identification, are completely grouped in one table, as under:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>When</th>
<th>From whom</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Colza</td>
<td>Jan. 23, 1855</td>
<td>A. L. Case.</td>
</tr>
<tr>
<td>2</td>
<td>Colza</td>
<td>Mar. 26, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>3</td>
<td>Colza</td>
<td>July 13, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>5</td>
<td>Mason's patent</td>
<td>Jan. 23, 1855</td>
<td>A. L. Case.</td>
</tr>
<tr>
<td>5bis</td>
<td>Do</td>
<td>July 18, 1855</td>
<td>L. H. B.</td>
</tr>
<tr>
<td>6</td>
<td>Non-gelatinous lard, (Theo. Adams)</td>
<td>Aug. 22, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>8</td>
<td>Seal</td>
<td>Jan. 23, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>9</td>
<td>Solar</td>
<td>Jan. 23, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>10</td>
<td>Sperm, (Curtis, Mitchell &amp; Co.)</td>
<td>Jan. 23, 1855</td>
<td>Do</td>
</tr>
<tr>
<td>11</td>
<td>Sperm, (E. M. Robinson)</td>
<td>Jan. 23, 1855</td>
<td></td>
</tr>
</tbody>
</table>

Of these, No. 11 is of the same sample designated as sperm_{34} in the first report; and some of the results (those, to wit, which are presumed to be independent of local circumstances, temperatures, &c.) obtained there have been again employed here. No 5^{bis} was supposed to be a specimen identical with the previous one already examined for the Light-house Board, and still more minutely, chemically, before for another party; and was, therefore, upon our suggestion, officially withdrawn. All the others were regularly and uniformly tested; more or less continuously, as the successive results seemed to require, and as will be specifically noted under the several heads hereafter.

The order of the examination is the same here as in the former report; only some of the items there given, and which were important for the special discrimination aimed at them, are omitted here as not essential to the more practical comparison intended now. And the motives and principles of the tests applied, the mode of applying them...
and the apparatus for their application, were then so fully discussed and
described as to render a repetition of such details unnecessary, and to
allow this report to be confined chiefly to the numerical results obtained,
and to their comparison under their several appropriate items. In this
way, this becomes justly a sequel to the former report; while, of course,
any instances in which conclusions hitherto considered as established,
have come, in these later observations to be modified, will be noted in
their proper place.

PHYSICAL PROPERTIES OR EXTERNAL CHARACTERS.

Density.—The following table exhibits the specific gravity, or den-
sity compared with water, of the different samples, observed at different
times and at varying temperatures, but reduced to a uniform tempera-
ture of 62° Fahr. The elements of this reduction are: for water, the
data derived from the experiments of Mr. Hassler by one of us, and
given in Silliman’s Journal, (Sec. Ser. xvi, 170;) and for oil, the factor
0.000423 per degree of Fahrenheit, established in our former report:

<table>
<thead>
<tr>
<th>No.</th>
<th>Samples</th>
<th>Observed at</th>
<th>Densities at 62° F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water</td>
<td>67½° F.</td>
<td>1.01408</td>
</tr>
<tr>
<td>2</td>
<td>Colza</td>
<td>73</td>
<td>1.01049</td>
</tr>
<tr>
<td>3</td>
<td>Colza₂</td>
<td>73</td>
<td>1.01413</td>
</tr>
<tr>
<td>4</td>
<td>Lunar</td>
<td>73</td>
<td>1.01644</td>
</tr>
<tr>
<td>5</td>
<td>Mason’s P</td>
<td>69½</td>
<td>1.01906</td>
</tr>
<tr>
<td>6</td>
<td>N. G. lard</td>
<td>73</td>
<td>1.01729</td>
</tr>
<tr>
<td>7</td>
<td>Rosin</td>
<td>69</td>
<td>1.01782</td>
</tr>
<tr>
<td>8</td>
<td>Seal</td>
<td>67½</td>
<td>1.03483</td>
</tr>
<tr>
<td>9</td>
<td>Solar</td>
<td>68</td>
<td>1.09206</td>
</tr>
<tr>
<td>10</td>
<td>Sperm, Mitch</td>
<td>66½</td>
<td>0.87578</td>
</tr>
<tr>
<td>11</td>
<td>Sperm, Robins</td>
<td>64½</td>
<td>0.88060</td>
</tr>
</tbody>
</table>

Fluidity.—The experiments on this were made with the same grooved
apparatus described in the first report, but in two sets, at different epochs.
when the temperatures also happened to vary materially. Three series,
of as many different inclinations, were also taken as before; but, in con-
sequence of accidental inattention, these series were not made of
the same number of terms, respectively, and, when finished, were found to
be not exactly comparable, but at one epoch of time and under one
inclination. A comparison of the results, however, as obtained, seems
to warrant our taking the one, where the period of time elapsed and the
inclination were identical, as sufficiently indicative of all; while the
point in question did not appear of practical importance enough, in its
present relation, to demand a repetition of all the sets and series of
experiments. The coincident result only, therefore, is presented, as
under:
Colza
Colza
Colza
Lunar
Mason
N. G. lard
Rosin
Seal
Solar
Sperm, M.
Sperm, R.

<table>
<thead>
<tr>
<th>Ratio of fluidity</th>
<th>Observed at—</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.618</td>
<td>570 mean.</td>
</tr>
<tr>
<td>0.921</td>
<td>750 mean.</td>
</tr>
<tr>
<td>0.896</td>
<td>750 mean.</td>
</tr>
<tr>
<td>0.671</td>
<td>750 mean.</td>
</tr>
<tr>
<td>1.973</td>
<td>570 mean.</td>
</tr>
<tr>
<td>0.892</td>
<td>730 mean.</td>
</tr>
<tr>
<td>0.700</td>
<td>570 mean.</td>
</tr>
<tr>
<td>0.945</td>
<td>570 mean.</td>
</tr>
<tr>
<td>1.856</td>
<td>570 mean.</td>
</tr>
<tr>
<td>1</td>
<td>570 mean.</td>
</tr>
<tr>
<td>1</td>
<td>750 mean.</td>
</tr>
</tbody>
</table>

All these relate to a uniform period of 71.5 hours, and a constant angular inclination with the horizon of 42 minutes of a degree. The Robinson sperm, which is regarded as a standard, was intended to be compared simultaneously in both sets; but, owing to a casual intrusion of some foreign substance into the groove containing said sample, it failed of its function during the first set; and is, therefore, rather arbitrarily, assumed to be equivalent there to the other, Mitchell sperm, which it so closely resembles in some other properties, and to have been identical in both sets. That it is not exactly so would appear from comparison of these later experiments with those of the first report, in which all the other circumstances, except the temperature, were the same, nearly. Thus:

1855, Feb. 10. Robinson sperm, after 71.9 hours, mean temperature 56°.5, stood 30.1 in.
1855, Sep. 1. Robinson sperm, after 71.5 hours, mean temperature 75°, stood 43.2 in.

It appears from this that the temperature is a much more important element than has been hitherto supposed in the various methods that have been contrived for experimenting on this characteristic of fluidity; and that to determine its theoretical functions, would require, among other things, a precedent determination of the delicate differences in the expansion by heat of the several oils, which expansion has undoubtedly erroneously been taken, nevertheless, with a sufficient approximation for practical purposes, as identical for all.

It is to be observed, however, that whatever may be the issue of this point it affects with error the ratio of fluidities only to the extent of the difference of behavior under changes of temperature, degree for degree, between the Robinson and Mitchell sperms—a difference that may be assumed to be ordinarily hardly perceptible.

This discussion of temperature leads naturally to the next characteristic of—

Affection by heat, one aspect of which, viz., expansion, was not considered necessary to observe, after what had been done and said in the first report; the other aspect, that of—

Cooling and solidification, had been experimented upon for these samples in the same manner and under the same precautions as for the former, and with the following results:
### Experiments upon Cooling and Solidification.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Colza₁</th>
<th>Colza₂</th>
<th>Colza₃</th>
<th>Lunar</th>
<th>Mason, P.</th>
<th>N. G. lard</th>
<th>Rosin</th>
<th>Seal</th>
<th>Solar</th>
<th>Sperm, M.</th>
<th>Sperm, R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Solidifying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Solidifying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick pellicle...</td>
<td>Pelticle...</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lt. pellicle</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lt. pellicle</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick pellicle...</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick pellicle...</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened less than C₂</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>less than C₂</td>
<td>Pelticle...</td>
<td>Peltie...</td>
</tr>
<tr>
<td>31.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>29.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thick milky...</td>
<td>Very viscid</td>
<td>Solid...</td>
</tr>
<tr>
<td>21</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>20</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>19</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>18</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>17</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>16</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>15</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>14</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>13</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>12</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>11</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>10</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
<tr>
<td>9</td>
<td>Very viscid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass thickened</td>
<td>Wh. deposit on therm.</td>
<td>Viscid...</td>
</tr>
</tbody>
</table>
Combustion.—In the experiments for this, the best of three samples of colza oil was taken, and the rosin burned with so thick and unavoidable a smoke as to render it totally unfit for purposes of illumination. The following table exhibits the important particulars with the rest:

<table>
<thead>
<tr>
<th>Samples</th>
<th>1st Period—60°</th>
<th>2nd Period—230°</th>
<th>3rd Period—320°</th>
<th>Average Consumption in gr. per min.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consumption in gr. per min.</td>
<td>Consumption in gr. per min.</td>
<td>Consumption in gr. per min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colza</td>
<td>1.5001</td>
<td>1.3685</td>
<td>1.2446</td>
<td>1.3811</td>
<td>0.80021</td>
</tr>
<tr>
<td>Lunar</td>
<td>1.9045</td>
<td>1.7013</td>
<td>1.4672</td>
<td>1.6910</td>
<td>0.9559</td>
</tr>
<tr>
<td>Mason</td>
<td>1.8683</td>
<td>1.5147</td>
<td>1.4838</td>
<td>1.5349</td>
<td>0.8803</td>
</tr>
<tr>
<td>N. G. Laird</td>
<td>1.9477</td>
<td>1.8631</td>
<td>1.7905</td>
<td>1.8904</td>
<td>1.0525</td>
</tr>
<tr>
<td>Seal</td>
<td>1.1554</td>
<td>0.9896</td>
<td>1.0283</td>
<td>1.0918</td>
<td>0.9242</td>
</tr>
<tr>
<td>Solar</td>
<td>1.2301</td>
<td>1.1829</td>
<td>1.1345</td>
<td>1.1758</td>
<td>0.9552</td>
</tr>
<tr>
<td>Sperm, Mitchell</td>
<td>1.0439</td>
<td>1.3358</td>
<td>1.4259</td>
<td>1.3347</td>
<td>0.89476</td>
</tr>
<tr>
<td>Sperm, Robinson</td>
<td>1.7403</td>
<td>1.7219</td>
<td>1.6745</td>
<td>1.7152</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Connected with these results, and influencing them, was mentioned, in the first report, a—

Carbonization and Coaling of the Wick, as characteristic of different oils. This topic has been since examined, and will be further treated of here. For this, one of the lamps employed in the experiments above, all of which were intended to be of the same dimensions and pattern in all respects, and do not appear to vary very materially, was measured carefully in its upper and lower diameters—it being a conic frustum—and in the height from the top of the wick-holder 1° to the normal surface of the oil when the lamps were full, and 2° to the bottom when the lamps were empty. The difference between these last is the effective height of the frustum of oil, when full. These dimensions were as follows: Upper diameter = 1.5 inch; lower diameter = 2.2 inch; height of frustum = 1.9 inch; further height from top of frustum to top of wick-holder = 1.1 inch. From these dimensions, the capacity of the lamp (= $Q_{\text{in.}}$) in cubic inches, at different levels, may be expressed in terms of the height ($h$) counted from the top downwards to said levels; and consequently, if those capacities, i.e., the volume of oil burned at different periods, be known, the corresponding value of $h$ may be calculated by the following formula, the numerical co-efficients of which are near enough for the present purpose, viz:

$$Q_{\text{in.}} = 1.7659h + 0.4341h^2 + 0.0355h^3.$$  

This formula was considered as applicable to all the lamps indiscriminately.

Next, from the known specific gravities of the oils, respectively, and from the known weights consumed of each during the three periods respectively given in the last table, it is easy to deduce the several volumes $Q_1$, $Q_2$, $Q_3$, consumed during those periods; and with the formula to calculate the several corresponding depressions of surface $h_1$, $h_2$, $h_3$, at the end of each of those periods. The half of these depressions is the average depression during the whole period respectively and such half added to the constant height (1.1 in.) between the original normal
surface of the oil and the top of the wick-holder where it is delivered for combustion, gives a series of values, $H_1', H_2', H_3'$, which correspond to and represent the average capillary action required in the wick during each of the periods aforesaid. Of course, $H_2$ being greater than $H_1'$, and so on, as the surface of the oil sinks, there is a corresponding increase of capillary work to be done by the fibres of the wick in (as it were) pumping up the oil for combustion, and a proportionate diminution in the quantity of oil consumed.

If the actual consumption in the several periods were found to be inversely in the ratios of $H_1 : H_2 : H_3$, they would show that the diminished consumption was due solely to the increased difficulty and spontaneous deficiency of the supply; but if, as was throughout these experiments and always is the case, the diminutions are in the higher ratio that $\frac{1}{H_1} : \frac{1}{H_2'}, \&c.$, it is plain, that there are some other causes affecting either the delivery or the combustion, or both.

Here, from the data at disposal, and probably from the nature of the case generally, it is impossible to distinguish among these causes; and they are therefore treated in the aggregate and comprehended under their two main aspects, by the terms carbonization and cooling; the former being considered to refer to a diminution or destruction of the wick itself, whereby its surface and consequently its capacity of discharge are lessened; and the latter, to an incrustation upon said wick, different in different oils, whereby the delivery and the combustion are both impeded.

Now, to calculate this aggregate, it is sufficient to consider that there are actual consumptions, expressed, say, in grains per minute, and denoted by $g_1, g_2, g_3, \&c.$, in a converging series, and values 1 : $1 + n : 1 + n', \&c.$, in a diverging series, resulting from the fractions $\frac{H_1}{H_1} : \frac{H_2}{H_2} : \frac{H_3}{H_3'} \&c.$, and corresponding to the increased capillary action demanded. The value of the first term of the converging series being taken as normal, we have the values affecting the succeeding terms otherwise than by capillarity, and denoted by $c$ and $c'$, obtained by the equations following:

on (A) $c = \frac{1}{1-n} \cdot g_1 - g_2 = \text{carbonization, } \&c., \text{dur'g 2d period.}$
(B) $c + c' = \frac{1}{1-n'} g_1 - g_3 = \text{do. 2d and 3d period.}$
$c' = \text{Eq. B} - \text{Eq. A} = \text{do. 3d period.}$

The numerical values to be substituted for $g_1, g_2, g_3$, are given in the last table; those of capillary height ($H_1$, $H_2'$, $H_3'$) and their ratios, $1 + n$, $1 + n'$, and finally of $c$ and $c'$, the amount of carbonization, $\&c.$, expressed in grains per minute, have been calculated, and are presented in the following table:
The carbonization, &c., during the first period of observation cannot be deduced from these nor readily from any observations. It has to be assumed as null; and, therefore, in any experiments of the kind undertaken for final precision, the first period should be as brief as possible, and at least very much shorter than the term which, in view of other more interesting results, was allowed here. But the ratio of the results for the two last periods, which results besides conform to and illustrate all the mechanical phenomena exhibited during the experiments, enables us to analogize in some degree the characteristic occurrences and relations for the first.

Thus, in the instances of colza and Mason’s patent, it is seen that the greatest deterioration of wick occurred during the second period. The carbonization is from 50 to 100 per cent. more in this than in the third. And it may therefore be inferred that the characteristic tendency of both these oils is to coal quickly, and that a considerable carbonization had already taken place during the first period. With the lunar and Mitchell sperm such deterioration appears nearly constant during the whole time, while in the other cases, except the solar oil, the wick grows gradually less efficient from period to period, and, as may be inferred, from the moment of lighting onwards. The seal oil only presents an anomaly—which is also accused in the Table of Combustion, and, indeed, arises out of the observation there of a larger quantity consumed during the third than during the second period—in giving a negative carbonization, thus indicating that the wick got better instead of worse, and became more efficient, to the extent of $\frac{6}{100}$ of a grain per minute, at last than at an earlier period. If necessary, this anomaly is not difficult of reconciliation. The seal oil has the tendency, already spoken of with regard to others in the first report, to form hoods or bonnet-like excrescences on the wick, which visibly affect the illumination, and no doubt the consumption of combustible, which at intervals fall off, refresh the light, and, of course, the vigor of consumption.

The Robinson sperm, undoubtedly the best of all the samples, maintains its precedence also in this aspect as producing or allowing the least deterioration of wick. But it is to be observed that the indications in this regard are not to be taken exclusively, nor at all except in connection with other circumstances, such as capillary depth, viscosity,
fluidity at various temperatures, &c., which influence the result. Indeed, the whole speculation under this topic may be considered as more curious than useful, nearly the whole of it being practically involved in and solved by the observations, to be quoted under the next head of—

Illumination.—These observations were made in the same manner and with the same standard candle as those in the first report. The product of the respective distances, the photometer being turned end for end, is used for the ratio of illuminations only, the samples being observed (purposely with a view to another point) always in the same order, instead of being reversed, there is a slight apparent advantage for those which came the earliest. This advantage is in a less deterioration of wick by about fifteen minutes’ burning between the earliest—the Robinson sperm—and the last, the solar oil. Except that the two sperms came first, the order of the others is the same alphabetical one which has been used in all the preceding tables. A column in the following table, however, for each series, showing the number of minutes from the commencement of the period to the epochs of the two observations, will show all this more particularly.

In view of the extent required for exhibiting all the details, it is enough to give for each series the proportionate illuminating power of the lamp flames, respectively, that of the candle being called unity; or, as the caption has it, the numerical percentage of “lamp in candles,” and the ratio of those illuminating powers. This is done in the following table:

<table>
<thead>
<tr>
<th>Samples</th>
<th>FIRST PERIOD OF 90 MIN.</th>
<th>SECOND PERIOD OF 230 MIN.</th>
<th>THIRD PERIOD OF 320 MIN.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Epochs</td>
<td>Lamp in can.-dies</td>
<td>Ratio of illumination</td>
</tr>
<tr>
<td>Colza₂</td>
<td>m.</td>
<td>m.</td>
<td>0.2591</td>
</tr>
<tr>
<td>Lunar</td>
<td>63</td>
<td>82</td>
<td>0.0355</td>
</tr>
<tr>
<td>Mason, P.</td>
<td>66.5</td>
<td>84.5</td>
<td>0.5930</td>
</tr>
<tr>
<td>N. G. (ard</td>
<td>67.5</td>
<td>80</td>
<td>0.5740</td>
</tr>
<tr>
<td>Seal</td>
<td>70</td>
<td>87.5</td>
<td>0.3353</td>
</tr>
<tr>
<td>Solar</td>
<td>71</td>
<td>89</td>
<td>0.3000</td>
</tr>
<tr>
<td>Sperm, M.</td>
<td>61</td>
<td>89</td>
<td>0.7216</td>
</tr>
<tr>
<td>Sperm, R.</td>
<td>58</td>
<td>79</td>
<td>0.7500</td>
</tr>
</tbody>
</table>

At the beginning of the third period, the colza₂ and lunar oils, which had already in the second exhibited a very low illuminating power, burned so badly and shed so feeble a light as to be altogether unfit for comparison. They are therefore omitted in the last three columns. The cause of this inferiority with colza, which in France is reputed to give such good results, cannot be stated other than hypothetically, in the sample being an adulterated or deteriorated one. The fact itself, as shown in these three series, is indubitable, and is further confirmed by two other series with the same sample, and four others with colza₁ and colza₂. The sample colza₂ was selected for this last comparison
because of its previously ascertained though slight superiority. How far a different mode of burning, as, for instance, with a draught of air through a glass chimney, or some means of aiding its weak and early-impaired capillary flow, as by hydrostatic pressure or mechanical delivery, there was no opportunity for ascertaining. No doubt such appliances would remedy in some degree its defects and afford a better result.

The seal oil exhibits here the same anomalous result in respect to illumination as before in regard to combustion and carbonization. It gave a better light, just as it consumed more with less deterioration of wick, in the last than the preceding period. This will be seen more readily in the following table, which gives the ratio of illumination for the respective samples through the three periods; the amount in the first being taken as unity:

<table>
<thead>
<tr>
<th>Samples</th>
<th>First period</th>
<th>Second period</th>
<th>Third period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colza</td>
<td>1. —</td>
<td>0.24360</td>
<td></td>
</tr>
<tr>
<td>Lunar</td>
<td>1. —</td>
<td>0.36141</td>
<td></td>
</tr>
<tr>
<td>Mason's P.</td>
<td>1. —</td>
<td>0.62988</td>
<td>0.34121</td>
</tr>
<tr>
<td>N. G. lard</td>
<td>1. —</td>
<td>0.54035</td>
<td>0.19785</td>
</tr>
<tr>
<td>Seal</td>
<td>1. —</td>
<td>0.58078</td>
<td>0.80436</td>
</tr>
<tr>
<td>Solar</td>
<td>1. —</td>
<td>0.89517</td>
<td>0.71793</td>
</tr>
<tr>
<td>Sperm, Mitch</td>
<td>1. —</td>
<td>0.66466</td>
<td>0.49784</td>
</tr>
<tr>
<td>Sperm, Rob.</td>
<td>1. —</td>
<td>0.91753</td>
<td>0.65668</td>
</tr>
</tbody>
</table>

A similar accord between the different results, thus independently obtained, holds also for the other samples in general; for the natural animal oils—the sperms and seal—this accord is nearly numerical, as will be seen by the following statement:

<table>
<thead>
<tr>
<th>ILLUMINATION RESULTS.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Observed</td>
</tr>
<tr>
<td>Calculated from carbonization</td>
</tr>
</tbody>
</table>

| Robinson's sperm | 1 0.92 0.66 |
| Mitchell's sperm | 1 0.66 0.50 |
| Seal             | 1 0.58 0.80 |

The other oils, which are either vegetable, as colza, or artificial, as all the rest, cannot be expected to present this accord and strict proportion with pure sperm; for the light-giving power, although to some extent indicable and controlled by the physical properties, such as fluidity, tendency to carbonize, &c., is yet more dependent upon the chemical constitution of the oil and the actual condition of the hydrocarbons it contains. These dependencies, unfortunately, allow themselves to be more readily conceived of and admitted than understood, and are more easily spoken about than explained.
It will be enough, then, under this topic, to give a final comparison of the economical values of the different samples; which value is directly in the ratio of observed illuminating power and inversely as the actual consumption for the different samples, respectively. To avoid a confusing multiplication of statements, these values will only be given for the first and last periods; the former representing the relations when the wick is yet clean or recently trimmed, and the latter the conditions after a continuous burning of five hours. After such an interval, the state of the colza and lunar lamp light is such as to exclude them from comparison:

<table>
<thead>
<tr>
<th>Sample</th>
<th>First period</th>
<th>Third period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colza</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Lunar</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Mason's P.</td>
<td>0.84</td>
<td>0.48</td>
</tr>
<tr>
<td>N. G. lard</td>
<td>0.70</td>
<td>0.22</td>
</tr>
<tr>
<td>Seal</td>
<td>0.71</td>
<td>0.94</td>
</tr>
<tr>
<td>Solar</td>
<td>0.58</td>
<td>0.65</td>
</tr>
<tr>
<td>Sperm, M.</td>
<td>1.62</td>
<td>0.86</td>
</tr>
<tr>
<td>Sperm, R.</td>
<td>1.</td>
<td>1.</td>
</tr>
</tbody>
</table>

Such are the particulars necessary to be stated under this head.

CHEMICAL CONSTITUTION OR INTERNAL PROPERTIES.

Homalism, or the presence of any uncombined acid or alkali in the samples, was severally tested as before. Immediately there was an acid reaction by colza; in all the others the test papers remained unchanged. After the lapse of two hours, a slight acid reaction was manifested in the two other samples of colza and in the Robinson sperm; the others were unchanged. And a similar result was shown after rather more than seven hours' exposure. They were not compared in this respect, at a high temperature; the observations for the former report being considered sufficient to establish the fact of acidity being always developed in boiling.

Qualitative associations.—These exist and are determinable, except in one sample, only by traces; which are denoted, according as large or small, by the letters t or s immediately after the name in the following table:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Product 1</th>
<th>Product 2</th>
<th>Product 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colza</td>
<td>gave</td>
<td>Chlorine</td>
<td>Soda</td>
</tr>
<tr>
<td>Colza</td>
<td>gave</td>
<td>Potassa</td>
<td>Soda</td>
</tr>
<tr>
<td>Colza</td>
<td>gave</td>
<td>Potassa, s</td>
<td>Potassa</td>
</tr>
<tr>
<td>Mason</td>
<td>gave</td>
<td>Potassa in larger proportion than traces.</td>
<td></td>
</tr>
<tr>
<td>N. G. lard</td>
<td>gave</td>
<td>Chlorine</td>
<td>Potassa</td>
</tr>
<tr>
<td>Seal</td>
<td>gave</td>
<td>Potassa</td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>gave</td>
<td>Chlorine, s</td>
<td>Potassa, s</td>
</tr>
<tr>
<td>Sperm, M.</td>
<td>gave</td>
<td>Potassa, s</td>
<td>Soda, t</td>
</tr>
<tr>
<td>Sperm, R.</td>
<td>gave</td>
<td>Chlorine, ss</td>
<td>Potassa, ss</td>
</tr>
</tbody>
</table>
The Robinson sperm is inserted here from the observations made for the former report. The rosin oil, which had shown itself entirely unfit for burning, was not examined in these relations.

The associations given above are probably more accidental than normal. But the behavior of the samples under the proper tests for these, and otherwise, enables us to assign to the fictitious oils in the list the palpable mode of their having been compounded. Thus, the lunar and non-gelatinous lard oils are substantially lard oil itself; the latter, more particularly, treated with turpentine or some volatile resinous oil, increasing fluidity. The solar oil, on a ticket which accompanied it, is called solar or lard oil; but this must be an error. It is a fish oil, and probably clarified whale oil. Mason's patent is also most likely a whale oil, treated with turpentine, benzole, and pearlash.

Whatever, however, may have been the methods, and whatever the design in the treatment of these samples, it is clear that they have failed to be successful in approaching the physical properties or practical advantages of unadulterated sperm.

Thermal tests.—These were applied as before, and gave the respective epitherms, or constitutional rise of temperature, as follows:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Epitherm.</th>
<th>Sample</th>
<th>Epitherm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colza,</td>
<td>97°.0 Fahr.</td>
<td>Rosin</td>
<td>53°.0 Fahr.</td>
</tr>
<tr>
<td>Colza,</td>
<td>91°.0 Fahr.</td>
<td>Seal</td>
<td>131°.0 Fahr.</td>
</tr>
<tr>
<td>Colza,</td>
<td>96°.5 Fahr.</td>
<td>Solar</td>
<td>117°.5 Fahr.</td>
</tr>
<tr>
<td>Lunar</td>
<td>73°.25 Fahr.</td>
<td>Sperm, Mitch.</td>
<td>83°.0 Fahr.</td>
</tr>
<tr>
<td>Mason’s P.</td>
<td>89°.5 Fahr.</td>
<td>Sperm, Rob.</td>
<td>76°.0 Fahr.</td>
</tr>
<tr>
<td>N. G. Lard</td>
<td>75°.75 Fahr.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The epitherm of the Robinson sperm formerly ascertained, the mean temperature before pouring being 74°.5 Fahr., was 69°.5. The present result is 70°. F. above a mean temperature of 78°. F. The Mitchell sperm gave an epitherm so unexpectedly different—viz., 82° above a mean temperature before pouring of 86° F.—that it was thought necessary to repeat the observations. They gave an epitherm of 80° above a mean temperature of 63° F. The theory of the epitherm is yet obscure; but it is probable that hereafter, in the use of this test, it will be found proper to apply a correction proportioned to the temperatures of the oil and acid before pouring.

But however this may be, these repeated observations serve to show the reliability of this peculiar test, and its constancy for the same sample under different circumstances. So far as the Mitchell sample is concerned, either the test is to be taken as showing very emphatically an inferiority, which was hardly to have been expected in an article which professes to be unadulterate and of the best quality, readily obtainable in the New York market, and which besides was so well marked in some other properties as to warrant its being regarded in the early part of this investigation as an equivalent to the standard Robinson sperm, or, if the two sperms are to be regarded as equivalents, the
wide margin between 70° and 82° of epitherm cannot but be alarming
to the confidence which hitherto, and upon apparently reasonable grounds,
we have been disposed to place in the test. In this dilemma it will be
instructive to compare the actual numerical results furnished by the
other tests for the two samples of sperm, respectively, as is done in the
following statement:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Sperm, Rob.</th>
<th>Sperm, Mitch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.88060</td>
<td>0.87578</td>
</tr>
<tr>
<td>Fluidity, (assumed)</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>Solidification, incipient, at</td>
<td>35° Fahr.</td>
<td>40° Fahr.</td>
</tr>
<tr>
<td>Rate of combustion, per minute, 1st period</td>
<td>1.75 grains.</td>
<td>1.65 grains.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>1.72 grains.</td>
<td>1.54 grains.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>1.67 grains.</td>
<td>1.42 grains.</td>
</tr>
<tr>
<td>Carbonization, &amp;c., do.</td>
<td>0.62 grains.</td>
<td>0.66 grain.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>0.63 grain.</td>
<td>0.68 grain.</td>
</tr>
<tr>
<td>Ratio of illumination, do.</td>
<td>1.</td>
<td>0.96 grain.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>1.</td>
<td>0.70 grain.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>1.</td>
<td>0.73 grain.</td>
</tr>
<tr>
<td>Deterioration of week, do.</td>
<td>2d do.</td>
<td>0.56 grain.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>0.92</td>
<td>0.66 grain.</td>
</tr>
<tr>
<td>Economical value, do.</td>
<td>3d do.</td>
<td>0.50 grain.</td>
</tr>
<tr>
<td>Do. do.</td>
<td>0.66</td>
<td>0.52 grain.</td>
</tr>
<tr>
<td>Homaliam</td>
<td>1.</td>
<td>0.86 grain.</td>
</tr>
<tr>
<td>Associated elements, residual</td>
<td>Chlorine.</td>
<td>Soda.</td>
</tr>
<tr>
<td>Epitherm</td>
<td>70° Fahr.</td>
<td>82° Fahr.</td>
</tr>
</tbody>
</table>

It will be recollected that, in its theory, the epitherm is to be counted
as progressing inversely with all the other characteristics except solidifi-
cation and carbonization; and it will be seen in the statement above
that it does actually so progress with the exception in the single item of
density, in the estimation of which, the numerical difference is so slight
as to be capable of being masked by possible errors of observation and
of correction for temperature.

Upon this remarkable accord, then, of so many distinct and inde-
pendent results, actually obtained and consistent with theory, it seems
proper to infer that the epitherm, so far from being regarded as discord-
ant, erroneous, or unreliable, is rather to be considered as possessing
the advantage of showing at once, more emphatically and upon, as it
were, a larger scale, differences which, in the observation of the other
characteristics, are more minute or have to be more circuitously deduced.
And we are led to the conclusion that the Mitchell sample, if unadulter-
ated, (as, from its low density, is most likely the case,) is nevertheless
an inferior quality of sperm, and not to be preferred when an article
identical with what has been here taken as the standard can be procured.

J. H. ALEXANDER.

CAMPBELL MORFIT.
THIRD REPORT ON OILS.

Addressed to Thornton A. Jenkins, Esq., U. S. N., U. S. Light-house Board.

Thornton A. Jenkins, Esq., U. S. N.,
U. S. Light-house Board, &c.

Baltimore, January 28, 1856.

Sir: I have the honor, herewith, of transmitting the report of Professor Campbell Morfit and myself upon the samples of oil for lighthouse use which you recently sent to me for examination.

The examination has been made of these samples in the same manner as of the former ones which have before been reported on, and in the statements of results those formerly obtained with the first sample furnished by Mr. Robinson, and contained in the first report, have been also introduced to serve as standards of comparison.

From these results it appears that all the samples are of fair winter sperm, except No. 2, No. 5, No. 6, and No. 8.

No. 5, a sample from Plumb Island light-house, delivered in the spring of 1854, is a fair summer sperm oil.

No. 2, a sample from Sankaty Head light-house, delivered in the past autumn, is a winter sperm which has been adulterated, accidentally, or by design. Nearly all the tests, physical and chemical, those which depend upon the point of congelation, the rate of consumption in burning and illuminative power, as well as the chromatic and thermal analogies, point to whale oil as the probable adulterant. And the epithem, taken with the margin that I have before spoken of as proper, in the present state of knowledge, to be attributed to this test, indicates the proportion of whale oil in the mixture as between seven and twelve per cent. Burned normally, its direct photometric value is not quite eighty per cent. of that of standard sperm, and a little over ninety two per cent. of the worst of those which have been classed as tolerable in the present series.

No. 6, a sample of so-called signal oil, from Mr. I. S. P., of Buffalo, N. Y., is avowedly an artificial oil. The results of tests, given by Mr. P. himself in a letter, of which you have caused me to be furnished with a copy, do not differ materially, as far as they go, from those obtained in the present examination. Thus, Mr. P. gives the density of his oil 0.92 at 60° F.; we found the density of the sample at 50.5 F., to be 0.91940, a difference which is favorable to the character of the oil. Mr. P. says further that it does not solidify till the temperature sinks below 20° F.; we found the sample gelatinous at 20.5° F., and at 17 F., solidified.

I do not know if I rightly understand the third attribute ascribed by the inventor to this oil, viz.: that of not undergoing decomposition until 612° F. This temperature, which is about the boiling point of fixed natural oils in general, and is, therefore, the epoch of their decomposition, was frequently attained in the application of divers of the tests used, at least the sample was frequently made to boil; but as this point of boiling is without interest in oils intended for illumination, its precise thermometric stand was not observed. If the inventor means that there
is no material vaporization until the whole mass boils, then this also is
borne out by our observations, which result in showing that there is no
appreciable mixture of a volatile substance in the sample.

As to the composition of this factitious oil, the color and odor of the
sample indicate at once its principal ingredient to be lard oil. And in
this indication, besides the tests of density and temperature of con-
gelation already spoken of, all the others accord, with the exception of
the rate or consumption in burning. In this last characteristic, it
stands the second of the present series, and is within six per cent. of
standard sperm. But its exhibition of such a high rate, though tolera-
ibly constant, is very brief; its light is extinguished spontaneously,
much sooner than that of any of the samples; and in the quantity of
unconsumed residue after extinction it stands pre-eminent. In none of
the others does this residue exceed twenty-three per cent. of the origi-
nal quantity in the lamp; this sample leaves not less than thirty-nine
per cent. Standard sperm leaves hardly four per cent., and that, prin-
cipally, in the wick.

From the odor, another partial ingredient may be assigned, viz:
some fish oil, and the chromatic test gives this as sperm.

In direct photometric value, it is next to the worst of the lot. It
burns for a longer time with a better light and higher photometric value
than pure lard oil; but the behavior of the wick during combustion is quite
similar to the case of lard. Like this last, it is favorable to the forma-
tion of bonnets and hoods upon the wick, which burn off and are re-
placed by new ones, elsewhere; thus yielding, even during its short
period of tolerable brilliance, a variable light. This characteristic car-
bonization of wick is quite peculiar to these two oils.

The epitherm of this sample is the highest of the series, and consid-
érably higher than that of lard; thus indicating at once an oil of low
illuminating capacity. And this indication is precisely borne out, nu-
merically, in the direct experiments on the two separate characteristics.

Although you desired an ultimate analysis to be made of this sample,
I have taken the responsibility of pretermittting it as yet, under the
conviction that the instruction to be derived from it would not be propor-
tionate to the trouble and expense of the operation. I believe
that when you have looked at the tabular results which follow, you
will approve of my caution, and concur with me in thinking that an
analysis is not called for. Should you, however, determine otherwise,
upon your advices to that effect, it will be promptly executed and
discussed, and the results forwarded to you.

No. 8, a sample furnished by H. S. K., of New York, is also
evidently an artificial oil, consisting, as appears from a combination of
tests, of lard oil, as a main ingredient, and also of a large proportion of
some volatile oil.

The specific gravity of this compound is nearly two per cent. less
than that of lard oil; its epitherm and illuminating capacity, shortly
after lighting, almost identical. Nearly identical, also, is its low
rate of consumption during combustion; but this, instead of being
followed, as in the case of lard oil, and of sample No. 6, by early
extinction, is protracted through nearly twenty hours, and until all the

61 L II P
oil in the lamp is exhausted. In this respect, it is almost, if not quite, as good as the best sperm, and in so far better, that it resists for about five hours longer the hardening and insipissating effect of the atmosphere.

This peculiarity was very interesting, as showing that the addition of the volatile oil, whatever it might be, had imparted a permanent fluidity to the mixture far above what lard oil in itself possesses, and had also relieved the wick, in great measure, from the incrustations and obstacles which lard oil alone creates. And it was, of course, a probable inference that, if the supply of combustible to the flame were augmented by mechanical means, an efficient and economical light might be obtained from this oil, which is so free from the objections and difficulties to which pure lard oil is justly liable. Accordingly, I began to experiment with it in a Carcel lamp but the observations came to a very abrupt termination, and I think myself fortunate in having been able to close them with sufficient quickness to avoid a serious explosion.

The existence and proportion of this volatile oil had been already determined by slow evaporation. The sample was now submitted to a more urgent heat, and, at a temperature below that of boiling water, it emitted a highly combustible vapor, which, under suitable intermixture with the atmosphere, would become readily explosive. Of course, this property unfit it, whatever might have been its merits in other regards, for light-house purposes, and renders unnecessary any further discussion of its behavior to the various tests.

In the former report—the second—upon a series of oils of which several samples of colza formed a part, the results came out very unfavorable, even upon the best of these samples. Thinking that these results, which were different from those ordinarily said to be attained with colza, might depend in some degree upon the manner of burning, and so would be modified by increasing the quantity of supply to the wick and rate of combustion, I have since repeated the experiments with the sample denoted as colza₂ in the report referred to, and compared them with similar ones, executed at the same time and under similar circumstances, upon standard Robinson sperm.

The combustion was had and the light measured in a small, single-wick Carcel lamp, capable of burning from twelve to fifteen grains of oil per minute. The ordinary chimney was used; and being without a damper, the only regulation of the volume and color of flame was in the adjustment of the wick and the elevation or depression of the stage carrying the glass chimney. These were so managed and varied as to produce in the two cases the best flames respectively, without regard to the other circumstances of either, except that the base of the flame was kept always at the same height above the table, so as to fall upon the same part of the photometer.

In consequence, I suppose, of the shortness of the chimney compared with the virtual height obtained in light-house lanterns by the additional sheet-iron tube that joins the glass chimney; and, at all events, in accordance with the strict injunctions of the lampist—Gould, of this city—who originally furnished and subsequently repaired the lamp for me, the wick was elevated more than in the ordinary mechanical lamp of light-houses. This elevation was, from the crest of the burner
to the comb of the wick, for the sperm 0.45 inch, and for the colza rather less, say 0.42 inch. The height of the shoulder of the chimney above the comb of the wick was, for the sperm 0.125 inch, and for the colza 0.200 inch. These adjustments produced, as far as I could judge, the largest and whitest flames, respectively.

After burning untouched for more than five hours, the lights were extinguished and the wicks examined. The sperm wick was found to be carbonized and crusted to a depth of 0.1875 inch; the lower part was unaltered. The colza wick was carbonized black to a depth of 0.25 inch below the comb, and the remainder, down to the crest of the burner, was brown; but there was no crust nor any hard points in the carbonized part, as with the sperm. The browning of the lower part appeared a natural consequence of a peculiar shrinking of the comb of the wick, which was manifested from the very first, and drew the entire wick over into a dome-like shape. The following are the numerical result:

<table>
<thead>
<tr>
<th>TIME—EPOCHS</th>
<th>LAMP, IN CANDLES</th>
<th>PHOTOMETRIC RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>16.81</td>
</tr>
<tr>
<td>190</td>
<td>215</td>
<td>15.79</td>
</tr>
<tr>
<td>390</td>
<td>310</td>
<td>13.92</td>
</tr>
</tbody>
</table>

Although it was intended, and would have been more satisfactory, that the time-ecchps, viz., the periods after lighting up, should have been the same for the two samples, yet circumstances prevented this identity. The difference of the periods, however, is so small as not to produce any material disparity.

I did not say before, although it follows from having spoken of but one lamp, that the experiments were not simultaneous, but successive, and, in fact, on two succeeding days. But the circumstances of atmospheric pressure and temperature were the same, and I considered the results more comparable than if they had been made at the same time with two different lamps.

The comparisons were made respectively with one of Judd's patent candles, six to the pound, as in former instances. This is the only element of uncertainty in the results, and I am not disposed to consider this as material in its effect. The consumption of spermaceti is very regular, viz. 1.98 grains per minute; and I am satisfied that, by having the wick of the same height and the pool of melted matter around its base of the same size at the several epochs of photometric measurement, a reasonable degree of identity in the flame, both as to volume and illuminating power, is attainable. Nevertheless, some more constant and uniform light is still to be desired. I mean, of course, something always on hand and easily accessible. An absolute standard, perma-
nent in all times and places, can be had (though it has never been proposed yet) by burning olefiant gas, issuing from an orifice of constant diameter, under a constant pressure. But this is not of ready resort, for the gas would have to be prepared for the purpose.

For comparison of different lights and reduction to the same scale, provided the nature of the inquiry allows the experiments to be compressed in a not very long period—say, not exceeding a day—and where the place of experiment is a large city the ordinary illuminating gas furnishes the best standard. Measured both as to volume and pressure in a special metre close by the burner, and kept uniformly regulated, it yields a light sufficiently constant until there is a fresh supply to the general gasometer. This light would be constant all the while if the supply was produced from the same materials in the same proportions and at the same temperature. But these conditions cannot be relied on longer than from day to day and thus produce the limitation just now mentioned.

It will be seen in the tabular results that the value of the lamp in candles, or its illuminating power, goes on diminishing as the period of burning is longer. This is different from the result affirmed by some observers, who find that the lamp-flame (of a Carcel lamp) increases in brilliancy through a period of five hours' continuous burning. Such an improvement, which is asserted in several books upon lighting by various authors, (but all copying, there is reason to believe, from one another, or, at least, from one and the same source,) is so inconsistent with the probabilities arising from the undisputed physical changes in the wick, that, even if its existence had been determined by a more unobjectionable comparison than was had in what I believe to be the original experiment, I should have considered the apparent result as affected by some certain though undiscovered error, and should have discarded it accordingly. I only refer to this point here lest you might think, from a recollection of some of these published authorities, that the present statement and result needed justification.

The last column of the statement gives the direct photometric value of the colza flame in terms of the sperm flame taken as unity. The progressive increase in this value is, I am satisfied, real, and not apparent only, both because the difference about the last epoch was very noticeable in advance of the photometric measurement, and because a difference in the same direction would be naturally dependent on the respective states of wick which have already been spoken of.

The mean of these several direct values may be taken as exhibiting the fair ratio of colza and sperm flames during a period of five hours. This mean results as 0.636 for colza, sperm being unity. But this is only the experimental illuminative ratio. To obtain the specific ratio of illumination, regard must be had to the quantities of material burned in the same time, respectively. This quantity is—for sperm, 14.4875 grains per minute, or 866.249 grains per hour; and for colza, 12.8496 grains per minute, or 770.977 grains per hour. The ratio of these quantities gives the proportionate consumption of colza as 0.892 when sperm is unity.

When the two oils were burned with a solid wick and natural flow the
consumptions were, respectively, 1.675 grains, and 1.247 grains per minute at the end of the same period as employed here; giving a proportionate consumption for colza of 0.743, and showing that an increase of very nearly one-fifth has been made in the consumption by means of the artificial supply.

Dividing the photometric ratio by the increased ratio of consumption, we have \( \frac{0.63634}{0.89393} = 0.713 \) as the specific illuminating ratio for colza compared with sperm. This ratio I have also called, in the former reports, the economical ratio, because it admits of a direct comparison of cheapness with price. Thus, if sperm be at $2 per gallon, colza would be its complete equivalent at $1.43. And this is so, leaving out of view the difference in specific gravity, amounting to about 8 per cent.; which is in favor of the colza, and allows an enhancement of its price.

The normal colza flame—that is, when, with an average consumption of 12.85 grains per minute, it is burning at its best—is smaller than the normal sperm flame, which is supported by the combustion of one-eighth more of material. But, volume for volume, the colza flame is to the eye more brilliant, and I do not doubt, photometrically, the more illuminative.

It also, however, requires more management. The limit between its purest white and the faint tinge at its apex, soon deepening into red, which is the index of incomplete combustion and the precursor of unmistakable smoke, is much sooner passed than in the case of sperm; which last, indeed, allows a considerable margin in the setting of the wick and the adjustment of the chimney. But when the proper points are once attained, the constancy of the colza flame is not less assured than that of sperm.

I am not aware of the price at which colza oil is to be obtained. But, upon the observations herein given, and the fair deductions to be made from them, there is no doubt that colza may be advantageously substituted for sperm in the light-house service whenever the cost of the former does not transcend seven-tenths of that of the latter.

Nor do I know if colza is obtainable in large quantities at any price, or at all. If it is, and you find reason, upon what has been said, as well as upon its reputed successful employment in France, to which I have had no reference whatever as yet, to encourage its introduction, I take the liberty of suggesting that this may be conveniently done by alternating its use with that of sperm at the Lazaretto light-house, in the harbor of this city. In this resort the question admits of being solved, after a short time, in the fullest and most practical way; and I shall be at your service, whenever desired, to give personal attention to the adjustment and management of the lights, respectively; their proper photometric comparison, and all other points that are necessary to be ascertained in order to come to a sound conclusion.

I have the honor of remaining, sir, your obedient servant,

J. H. ALEXANDER.
REPORT.

The oils herein reported on were all transmitted directly from the Light-house Board, and were labelled, numbered, and received as follows:

No. 1. U. S. winter sperm from lakes, 1855; rec'd 26th Nov.
No. 2 Sperm from Sankaty Head L. H., Oct., 1855; "
No. 3. U. S. contract, summer oil, 1855; "
No. 4. U. S. contract, winter oil; "
No. 5. Plum L. L. H.; delivered in spring of 1854; "
No. 6. Signal oil from Buffalo, N. Y.; "
No. 7. Sperm oil from E. M. Robinson, N. Bedford, rec'd 15th Dec.
No. 8. Oil from H. S. K.; "

Examination has been had of the material characteristics of each, in the same manner as more fully detailed in former reports upon other samples, and with the following results:

PHYSICAL PROPERTIES OR EXTERNAL CHARACTERS.

1. Color.—Except in the samples No. 6 and No. 8, there is nothing distinctive in this respect. Arranged in order of increasing depth of tint, they all stand as follows:

No. 6. Pale gold. No. 4. Deeper gold than No. 1.
No. 7. Golden. No. 3. +
No. 5. + No. 2. Deepest of all.

2. Odor.—In this respect, also, there is nothing to attract observation, except with the samples No. 6 and No. 8. The first, No. 6, has a decidedly lard-like odor, with a faint after-smell of fish-oil. The other, No. 8, emits a strong, peculiar, and persisting fragrance like that of benzole, which has been probably disguised, partially, by the addition of some aromatic essential oil, most likely peppermint.

3. Density.—The temperature of the chamber in which the observations for this item were made, and where the samples had been left to stand in their proper beakers for several hours, was at the beginning of the weighings 50° F., and 51° F. at their close. The resulting densities were as follows:

<table>
<thead>
<tr>
<th>Water</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>No. 5</th>
<th>No. 6</th>
<th>No. 7</th>
<th>No. 8</th>
<th>Robinson sperm</th>
<th>1st report</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.88605</td>
<td>0.88660</td>
<td>0.88475</td>
<td>0.88660</td>
<td>0.88512</td>
<td>0.91940</td>
<td>0.8812</td>
<td>0.89679</td>
<td>0.88420</td>
<td>Reduced to 50° 5 F. from 64° 5 F.</td>
</tr>
</tbody>
</table>

In these weighings the immersion of the wire was so nearly constant that no correction has been made for this item in the calculations. It may be safely neglected. Reduction to a standard temperature of 62° F. would affect the given densities in the sense of diminution and in the third decimal place only. With No. 6 and No. 8 such reduction would be, of course, the greatest. With the other samples it will be nearly constant, and equal to about —0.004.
No. 5, which is an oil easily congealed, gave evidence of this in a slight deposit of crystals. Its specific gravity, then, determined in this state, is somewhat too low, but not sufficiently abnormal, as it appeared, to require a repetition of the observations for it at a higher and more favorable temperature.

The specific gravity heretofore obtained for the Robinson sperm, which may be justly looked upon as a standard oil, has been reduced to the temperature of these observations, and entered, as matter of interesting comparison, in the table. It serves to show that all the samples, except No. 6 and No. 8, are quite satisfactorily constituted in this item of density. The basis of both these Nos. appears so far to be lard oil.

4. Congelation and solidification.—Experiment was made on these characteristics, both in the artificial method and with the precautions formerly described; and also in what may be termed the natural method, by exposing the several samples, in flasks, to the external atmosphere, whose extremely low temperature at one time, and for some days, was favorable for such observations. The following statement exhibits the results in this particular:

<table>
<thead>
<tr>
<th>Temp.</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>No. 5</th>
<th>No. 6</th>
<th>No. 7</th>
<th>No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Solidified at most through out.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td>Ring forming</td>
<td></td>
<td></td>
<td>Milky ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td>Clouding at B</td>
<td></td>
<td>Ring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ring</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Ring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36.5</td>
<td></td>
<td></td>
<td></td>
<td>Clouded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Gelatinous</td>
<td></td>
<td></td>
<td>Gelatinous Ring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td>Solidifying</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Solids at B</td>
<td></td>
<td>Clouding at B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Solidified at B</td>
<td></td>
<td>Gelatinous</td>
<td></td>
<td>Solid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Clouding at B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Solids at B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.5</td>
<td></td>
<td></td>
<td>Clouding at B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>Gelatinous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.5</td>
<td></td>
<td></td>
<td>Solid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td>Clouded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>Solids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>Solidified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The artificial temperatures were not carried below 25°.5. No. 5 sample, which was immersed in a bath of about 23°, being itself at a temperature of about 62°, was solidified so promptly as to give no opportunity for observing its preceding stages. As it was no doubt a summer oil, an old delivery, and from a stock probably by this time exhausted, it was not supposed of interest to repeat the observation.

5. Consumption of oil in combustion.—As in former instances under this item, the lamps were filled, weighed, lit, allowed to burn for a certain interval, extinguished simultaneously, reweighed, and so on. In
this instance, the last period extended to their final spontaneous extinction, the epoch of which was different for the most of the samples. The comparison of the times with the weights, respectively, gives the rate of consumption; which is expressed in grains per minute, as in the following table:

<table>
<thead>
<tr>
<th>Sample</th>
<th>FIRST PERIOD.</th>
<th>SECOND PERIOD.</th>
<th>THIRD PERIOD.</th>
<th>Average consumption</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td>Consumption</td>
<td>Time</td>
<td>Consumption</td>
<td>Time</td>
</tr>
<tr>
<td>No. 1</td>
<td>185</td>
<td>1.5069</td>
<td>316</td>
<td>1.6045</td>
<td>935</td>
</tr>
<tr>
<td>No. 2</td>
<td>185</td>
<td>1.4199</td>
<td>316</td>
<td>1.4639</td>
<td>905</td>
</tr>
<tr>
<td>No. 3</td>
<td>185</td>
<td>1.5286</td>
<td>315</td>
<td>1.5663</td>
<td>935</td>
</tr>
<tr>
<td>No. 4</td>
<td>185</td>
<td>1.5274</td>
<td>316</td>
<td>1.4997</td>
<td>905</td>
</tr>
<tr>
<td>No. 5</td>
<td>185</td>
<td>1.6531</td>
<td>315</td>
<td>1.5720</td>
<td>795</td>
</tr>
<tr>
<td>No. 6</td>
<td>185</td>
<td>1.6760</td>
<td>316</td>
<td>1.6062</td>
<td>635</td>
</tr>
<tr>
<td>No. 7</td>
<td>185</td>
<td>1.6039</td>
<td>315</td>
<td>1.5017</td>
<td>835</td>
</tr>
<tr>
<td>No. 8</td>
<td>185</td>
<td>1.4972</td>
<td>315</td>
<td>1.3801</td>
<td>1165</td>
</tr>
<tr>
<td>Robinson's Standard</td>
<td>125</td>
<td>1.7988</td>
<td>320</td>
<td>1.7814</td>
<td>905</td>
</tr>
</tbody>
</table>

The last line refers to the observations formerly had in this particular upon the sperm₃₄, furnished by Mr. Robinson, and to be found in the first report. The rate of burning of this oil was so uniform for a considerable period that the factor, deduced from a period of 125 minutes, may be safely applied to a period of 185 minutes; while, as between periods of 315 and 320 minutes, the probable variation and consequent error will be still less. Upon these two, then, and upon a third term observed and given in the former report, the series has been extended, by interpolation, to a term corresponding to 906 ½ minutes, which evidently may be used for 905 minutes, the actual mean of the times belonging to the third period of the table. And the average consumption for this oil, thus obtained from the observed and interpolated terms, has been used to establish the ratio given in the last column. This ratio, if not numerically exact, at least serves usefully in the way of illustration.

Connected with the rate and duration of combustion is the quantity of oil left unconsumed in the lamp at its spontaneous extinction. The particulars of interest in this respect are assembled, as observed in the following table:

<table>
<thead>
<tr>
<th>Samples</th>
<th>WEIGHT OF—</th>
<th>Proportion unconsumed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial oil</td>
<td>Residual oil</td>
</tr>
<tr>
<td>No. 1</td>
<td>2.7947</td>
<td>0.1229</td>
</tr>
<tr>
<td>No. 2</td>
<td>2.7907</td>
<td>0.5449</td>
</tr>
<tr>
<td>No. 3</td>
<td>2.7652</td>
<td>0.1307</td>
</tr>
<tr>
<td>No. 4</td>
<td>2.7075</td>
<td>0.5921</td>
</tr>
<tr>
<td>No. 5</td>
<td>2.6971</td>
<td>0.6108</td>
</tr>
<tr>
<td>No. 6</td>
<td>2.8235</td>
<td>1.0904</td>
</tr>
<tr>
<td>No. 7</td>
<td>2.7252</td>
<td>0.3697</td>
</tr>
<tr>
<td>No. 8</td>
<td>2.7752</td>
<td>0.1879</td>
</tr>
</tbody>
</table>
To ascertain how much oil remained in the body of the lamp, and how much was absorbed by and retained in the wick, experiment was made upon four of the samples, among those which had the least and those which showed the most residuum. A wick of the size employed—thirty threads five inches long—was weighed clean, and then the four greasy wicks weighed as they were, separately. The smallest quantity absorbed by the wick was in the case of No. 7, and amounted to 0.0943 oz. troy; the largest in the case of No. 8, amounting to 0.1283 oz. The mean of all four was 0.1060 oz.

Comparing this with the last table, it will be seen that samples No. 1 and No. 3 left hardly any free oil unconsumed, while No. 6 was hardly more than half of its original amount burnt away. These differences, no doubt, arise from normal variations in the respective fluidities of the samples and in the carbonization of wick which they severally superinduce, and also from accidental disparities in the wicks themselves. Such disparities hardly, if at all, allow themselves to be detected by any system of observation; but they cannot, at any time, with reasonable precautions, be considerable. The other elements—fluidity and carbonization—have already been the subjects of investigation in the two previous reports, and the method shown by which they are to be, at least approximately, deduced from the observations.

These methods would be again exemplified here were it not that the samples which exhibit the most remarkable differences in these respects, and would, therefore, be of the most interest to be applied as tests of the methods, are found in other important practical relations—such as, for example, their photometric ratios—to be so far inferior as to render the investigation of causes leading to that inferiority a matter comparatively of indifference. We may, then, pass on at once to the —

6. Illuminating power of the several samples. For this, the mean of three sets of photometric observations, made at successive epochs of an hour and a half, three and five and a quarter hours after lighting, has been taken to give the value of the respective lamp-flames in terms of a standard candle. And the results obtained for the first report from the Robinson sperm, whose epochs agree nearly with these last, have been added for more satisfactory and complete illustration.

<table>
<thead>
<tr>
<th>Sample</th>
<th>PHOTOMETRIC VALUES</th>
<th>OIL CONSUMED</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>0.7307</td>
<td>0.9743</td>
</tr>
<tr>
<td>No. 2</td>
<td>0.5989</td>
<td>0.7973</td>
</tr>
<tr>
<td>No. 3</td>
<td>0.6467</td>
<td>0.8623</td>
</tr>
<tr>
<td>No. 4</td>
<td>0.6480</td>
<td>0.8640</td>
</tr>
<tr>
<td>No. 5</td>
<td>0.6618</td>
<td>0.8824</td>
</tr>
<tr>
<td>No. 6</td>
<td>0.5814</td>
<td>0.7752</td>
</tr>
<tr>
<td>No. 7</td>
<td>0.7171</td>
<td>0.7851</td>
</tr>
<tr>
<td>No. 8</td>
<td>0.5365</td>
<td>0.7153</td>
</tr>
<tr>
<td>Robinson standard, 1st report, say</td>
<td>0.75</td>
<td>1,—</td>
</tr>
</tbody>
</table>
The first column of this table contains the samples; the second, the experimental value of the respective lamp-flames; while the third gives their proportionate value compared with the Robinson standard. The last two columns of actual and rational consumption have been added as the materials for arriving at an economical value of the several samples.

This economical value reposes on the assumption that with the same oil there is a constant ratio between the illumination and the quantity consumed in a given time; if such quantity be doubled, for instance, the illumination or direct photometric value will be double also, and so on. Numerically, it will be then directly as the experimental photometric values, and inversely as the grains consumed per minute; and the economical value or specific illuminative power, as it was termed in the first report, is the experimental photometric value reduced to what it would have been had the consumption per minute been the same for all the samples.

The determination of the specific illuminative power is of practical utility when, as between several samples, the direct photometric values and quantities consumed in a given time do not differ by any large amounts. In such cases, the advantage is sometimes demonstrable in preferring a cheaper, though photometrically inferior, oil, whose luminiferous deficiency may be remedied by management of the lamp or special contrivance for increasing its normal rate of consumption. And a similar determination is also applicable in cases, like some of the present, where the differences referred to are considerable, for making a still more palpable contrast. Thus, in the last table, the direct photometric value of No. 6 does not differ very materially from that of No. 2, yet the economical values will come out quite far apart; for, in a given time, one sample is consumed more, by one-sixth part, than the other. This will be seen in the following table:

<table>
<thead>
<tr>
<th>Samples</th>
<th>Economical ratio</th>
<th>Samples</th>
<th>Economical ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>1.0254</td>
<td>No. 6</td>
<td>0.8172</td>
</tr>
<tr>
<td>No. 2</td>
<td>0.9940</td>
<td>No. 7</td>
<td>1.0130</td>
</tr>
<tr>
<td>No. 3</td>
<td>0.9696</td>
<td>No. 8</td>
<td>0.9070</td>
</tr>
<tr>
<td>No. 4</td>
<td>1.0082</td>
<td>Robinson standard</td>
<td>1. —</td>
</tr>
<tr>
<td>No. 5</td>
<td>0.9823</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The decided inferiority of samples No. 6 and No. 8 is here quite apparent. The others are not very materially below the standard sample, and some even, as No. 1, No. 7, and No. 4, are above it. That is to say, taking the instance of No. 1, if the consumption of this could be augmented 5 per cent. by any management or contrivance—and in the lamps used for these observations an addition of two threads to the wick would be adequate to this augmentation—the light given would be 2\(\frac{1}{2}\) per cent. more than by the normal combustion of the Robinson standard flame. And if the oils were, weight for weight, at the same price, the sample No. 1 would be the cheaper. No. 2, on the contrary, would
require eight threads to be added to the wick, and then its light would be one-half per cent. worse than the Robinson flame. Such an addition of wick could not be made in the lamp employed for these experiments without changing its pipe; and this serves, in its measure, as an indication of the practical limits which are set by the circumstances and construction of apparatus, to a choice among oils upon considerations like these. In the Fresnel apparatus these limits are restricted by the conditions of the angles, &c., of the glass prisms, whose dimensions and position must always be with reference to the size of the flame in the common focus. Now, sample No. 6, the signal oil from Buffalo, would require an augmentation of volume in its flame amounting to nearly 25 per cent., in order to equalize its illumination with that of the Robinson sperm. If the two flames were already normally of the same volume on the mechanical lamp of the apparatus as they appear to be in the experiments with a solid wick—the difference appearing to be in a different intensity of light accompanying combustion—it need not be matter of conjecture how far the change of size in the signal oil flame would interfere with and frustrate the action of the catadioptric parts of the apparatus.

CHEMICAL CONSTITUTION OR INTERNAL PROPERTIES.

1. Homalism.—All the samples remained quite neutral, showing neither acid nor alkaline reaction for a period of 18 hours. At the end of that period all, except samples No. 6 and No. 8, began to manifest a slight acid reaction.

2. Qualitative associations.—In the several samples were found traces of various substances, as follows:

No. 1 gave chlorine and soda.
No. 2 gave chlorine, potassa, and soda, l.
No. 3 gave chlorine, s, and soda, s.
No. 4 gave chlorine, s, and soda, s.
No. 5 gave chlorine, potassa, and soda.
No. 6 gave chlorine and potassa.
No. 7 gave chlorine, potassa, and soda.
No. 8.
Robinson’s standard gave chlorine s, and potassa, s.

The letters l and s here, as in the former reports, signify that the traces of the substance to which they are annexed, are large or slight. The reduplication of the same letters indicates a higher degree of the characteristics, respectively.

Sample No. 8 was found further to contain 0.1612, by weight, of a volatile oil, which cannot be ascertained more nearly than that it is some liquid hydro-carbon belonging to the benzole series. The volume operated on was found to have been reduced after evaporation by 0.1765 nearly, which shows a specific gravity for the matter volatilized not much less than that of the fixed mass. But this observation does not pretend to extreme precision.

3. Chromatic tests.—These were applied by means of sulphuric and nitric acids and caustic soda, in the same way as described in former
reports. All the samples, except No. 2, No. 6, and No. 8, gave the normal reaction of pure sperm.

No. 2, by comparison, indicates a small admixture of whale oil with sperm.

No. 6, whose fishy odor, mingling with the smell of lard, has been already spoken of, emitted the former still more decidedly upon saponification. The comparison of mixtures in a chromatic scale showed that there was no whale oil present, and the sample in question corresponded with a mixture composed of 0.89 lard oil and 0.11 sperm.

No. 8, gave no indications of fish oil of either kind.

4. Thermal tests.—The epitherm of the several samples, or the elevation of temperature produced in each by the addition of a certain quantity of sulphuric acid, as described in former reports, was observed as follows:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Epitherm</th>
<th>Sample</th>
<th>Epitherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>79.6 F</td>
<td>No. 6</td>
<td>89. F</td>
</tr>
<tr>
<td>No. 2</td>
<td>85.</td>
<td>No. 7</td>
<td>77.3</td>
</tr>
<tr>
<td>No. 3</td>
<td>78.4</td>
<td>No. 8</td>
<td>78.4</td>
</tr>
<tr>
<td>No. 4</td>
<td>77.</td>
<td>Robinson standard</td>
<td>70.</td>
</tr>
<tr>
<td>No. 5</td>
<td>76.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These tests, in the cases of the undoubtedly adulterated samples, will be found to accord very tolerably with the results of direct photometric comparison. If we assume that the two tests are strictly proportionate, No. 2 ought to have a photometric value, calculated from the epitherm of 0.6176 candles, instead of 0.5980 candles, as observed, or vice versa, an epitherm of 87° F. calculated, instead of 85° F. observed. In the same way No. 6 would have a calculated epitherm of 90° F., instead of 89° F., and a calculated photometric value of 0.5899, instead of 0.5814 observed.

As for No. 8, which contains no fish oil, but whose adulterations are of vegetable origin and of some substance whose epitherm is yet unobserved and unknown, it cannot of course come into the category of being calculated at all.

The other samples without having been adulterated in store, as is probable, are yet shown to be oils inferior to the standard by this test as by all the others, though the indications do not run parallel. The discrepancies existing here only make it of more interest to explore thoroughly and determine the epithermal limits which belong normally to the class of pure native sperm oils.

J. H. ALEXANDER.
CAMPBELL MORFIT.
Gentlemen: I have the honor herewith to communicate certain experimental results, and to offer some suggestions upon the subject of steam fog-signals, which you were pleased to refer to me some time ago. The observations and all that part of the investigation which depended on myself have been completed many months since; the plan of the apparatus, the estimates of cost, &c., which required the technical cooperation of others in whose art such things lie, have been delayed by circumstances over which I had no control.

The difficulties of the question did not occur so much in the want of efficiency in the agent—steam—or in the implement—the ordinary steam whistle—proposed to be employed, as in the judiciousness of the application and economy of adaptation. The former point had been long since settled by the experience of railroads, where it had been found that sounds through such an implement were distinctly audible and characteristic over distances of six and seven miles—distances at least thrice as great as are demanded for signals in the light-house service. The latter points remained, however, for investigation.

These are supposed to be covered and satisfied by the determination of the quantity of steam at various pressures blown off through the whistle in given times; of the size of boiler necessary to supply the required quantity of steam; of the cost of construction and maintenance of such boiler and its equipment; of the fuel for and attendance upon the same; of the aptitude of the ordinary light-house keepers for such attendance; and, finally, of the risk incurred either from disaster of explosion or from deficiency of steam to answer its duty. These, then, are the principal topics treated of in what follows.

In advance of these, however, and in reference to what was just now said upon the sonorousness and space-penetrating power of the ordinary steam whistle, the course of the observations furnish some results that may be noted. On three several days, between two stations, three and a half miles apart in a straight line—the one being at Winans's locomotive works where the whistle was erected, and the other at or near the Lazaretto—the whistle, blown with peculiar mots (in order to distinguish it from any other chance engine whistle) every five minutes between 10 a. m. and 2 p. m., was distinctly audible at all pressures between 25 lbs. and 62 lbs. per square inch, and at all sets of the bell between 1.5 inch and 2 inches; the set of the bell, i. e., the distance of its lower edge from the orifice whence the steam issues, of course varying inversely the pitch of the musical sound emitted.

The mode in which these observations were made was this: An intelligent and reliable assistant, whose watch had been set with my own, was stationed at the boiler, and instructed to blow the whistle every 5 minutes from the hour agreed on for starting, and to note successively the pressures in pounds above the atmosphere, read on an Ashcroft steam gauge which had been adjusted to the boiler, corresponding to the epochs of time respectively. I myself went meanwhile to the Lazaretto station,
and there noted the time epochs and the audibility of the signal and other circumstances, such as the wind, &c., tending to modify such audibility. The actual pressure at the several epochs, which of course was unknown to me during the observations, was afterwards supplied from the memorandum of the assistant. I was glad to find, upon thus filling up the table of observations, that my recorded impression of the intensity of the sounds coincided directly with the scale of pressure. On one of these days, in particular, the wind was very strong in gusts, blowing at an angle of about 50° with the line joining the two stations. I had no means of measuring the force of this wind, and still less of measuring the intensity of sound; but I find upon the journal cases of less audible sound under a stronger wind coupled with differences of pressure of steam of 5, 6, and 7 pounds. The perturbation then, and loss of effect caused by the different force of the wind, was at least equivalent to the recorded differences in steam pressure. This loss of effect became more discernible still, when, in addition to change of force, there was also, as in some instances, a change of direction in the wind. A difference of this latter sort, amounting to say 10° or 12°, corresponds in one case to not less than 10 lbs. of steam pressure.

These approximate evaluations serve to show that the influence of this circumstance—the strength and direction of the wind—is quite important in estimating the effect to be expected from a given fog-signal. And the point would have been further and more particularly studied, had I not understood that the distance between my two stations was excessive, in fact more than double of what would be demanded of fog-signals in the light-house service. If this is not the case, then it would be interesting and useful to pursue the research in this aspect more thoroughly.

It is also to be stated that, in these experiments, the whistle was adjusted at a considerable height—say thirty feet—above the top of the boiler. This position was necessary in order to carry it outside and clear of the ridge-pole of the roof. As it was, there were still buildings of greater height intervening on the line between the two stations; a disadvantage to which a regular fog-signal will not be exposed. But, however this may be, the length of pipe through which the steam had to pass from the boiler where its pressure was measured to the place of exit where its pressure was efficient, contributed to its cooling and to a consequent loss of elasticity. The recorded pressures, then, are all somewhat too high. How much too high I am not able to say with any precision; for I did not then see, as I think I do now, how a reliable steam gauge could be suitably applied at the orifice of the whistle. An approximation, however, to the probable loss of pressure in the steam pipe may be obtained by the following considerations:

From Tredgold's experiments* it appears that the effect of radiation from iron pipes of the same character of surface with those used in our case may be expressed by the following equation:

\[ 0.000738 \times (T - t) = n, \]

in which \( s \) is surface in square feet of cooling cylinder; \( T \) is assumed tem-

perature of such surface; \( t \) is assumed temperature of surrounding medium, and \( n \) is number of degrees Fahr. to which one cubic foot of water will be heated in one minute by radiation from and contact with such cooling surface.

In the case in question, an inch pipe thirty feet long has a surface of 7.854 square feet; the temperature of the enclosed steam at forty pounds above atmospheric pressure is 289° F., which may be taken as the equivalent to the temperature of the surface itself, and a fair average of all the pressures observed, while the external temperature during the experiments was pretty steadily about 79° F. Also, as the cooling of the radiating mass and the heating of the absorbing one are absolutely the same, and the expressions for both correlative with their respective specific heats, and as the specific heat of steam at the temperature and density here taken is nearly 0.0007, that of water being 1, at the same volume we have \( n' = \frac{n}{0.0007} \) = the number of degrees Fahrenheit to which one cubic foot of steam will be heated, if that be considered the standard of effect instead of water, under the same circumstances.

Substituting these quantities, we have the numerical equation—

\[
0.00074 \times 7.85 \times 210° = 0.0007 n', \text{ and finally } 1714.7° = n'
\]

for the number of degrees that one cubic foot of steam will be cooled in one minute under the given conditions. This cooling would be equivalent to the entire condensation of more than one cubic foot; but during the period of one minute the quantity discharged through the whistle has been 225 cubic feet; so that the effect upon the whole mass of steam during the given interval, supposing that mass to be presented all at once, isolated and left to cool gradually, will be \( \frac{1714.7°}{225} = 7.6° \) nearly in reduction of temperature. This reduction from 289° F. to 281.4° F. corresponds to a loss of pressure of very nearly 6 pounds,* so that the recorded pressure of 40 pounds above the atmosphere becomes probably in fact but 34 pounds. This reduction, will, of course, be greater for the higher pressures and less for the lower ones; but it is not necessary to calculate for any but the average.

It appears, then, from the experiments that the steam whistle, at its ordinary set, utters sounds which are audible at a distance of 8.5 miles, in a calm atmosphere, under an actual pressure of 20 pounds and upwards; that these sounds are sufficiently distinct, even when thwarted by a strong wind, at a pressure of 40 pounds; and that a competency of the boiler to work at a pressure of 75 pounds will probably render it effective under the most unfavorable circumstances. All these pressures are rated above that of the atmosphere.

In endeavoring to make a scale of audibility and distinctness, under these various conditions, other than the momentary impressions on the individual auditory nerve, which is liable to capricious alterations of sensibility, resort was had to an indication that was of interest also in other respects. This was the precision with which the local source and

---

direction of the sound could be assigned. Uniformly the fainter the sound, the more vague is its presumed direction, while in proportion as its intensity increases, it can be ascribed within small and smaller limits to a particular quarter. In applying this test, the best mode I could devise was to close my eyes just before the moment when the sound was expected, to turn round two or three times in order to confuse and lose as much as possible any conscious orientation, and then when I heard the sound to point, still with eyes closed, in the direction along which it seemed to reach me. As the station itself was visible from where I stood, the deviation of the supposed from the true line was readily observable.

As an additional precaution to prevent the mere mechanical repetition of a previous impression, the observer’s station was not a single point, but was varied in a range of three or four hundred yards. When the pressure was 40 pounds and upwards, the direction of the whistle could always be determined within an estimated arc of three or four degrees. Between nearer stations there is no doubt of ability to determine the direction within a much smaller arc; and upon the whole it may be said that, in respect to this essential characteristic of a reliable fog-signal, the precision with which its site can be assigned from its sound, the arrangements as experimented on seem to be sufficient for the purpose.

In connection with this characteristic, observations were made upon the effect, from altering the tone of the whistle or the pitch and timbre, of the sound emitted. This is done by raising or lowering the bell above the orifice whence the steam issues; and it will be better understood by reference to the accompanying drawing in section of the steam whistle, and to the explanations and description which follow.

On the drawing, A B shows an iron stem, tapped at the end A, with a long screw thread, along which travels, in being elevated or depressed, the bell or inverted goblet C D E, of brass, whose lip, C E, is worked down to as fine a feather-edge as possible. The other end, B, of the stem, is enlarged, so as to leave room for turning out the cylindrical chamber N, one-half length of the walls of which are likewise screw-tapped, in order to enter and hold steam-tight the erect hemispherical cup H K L M. The screw thread is continued in the shank of the cup in order to couple with the exhaust steam pipe from the boiler. The walls of the chamber N, above the screw, are pierced with a suitable number of openings, O O, which allow the passage of the steam from the said exhaust into the body of the cup. The quasi lid of the cup Q Q, of brass, is attached to and rests on a shoulder of the stem B, and is separated from the lip H M by a space of about one-fiftieth of an inch, thus leaving an annular opening of that width all round the lip. The principal pains to be taken are in the central adjustment of the cup and lid, so that the opening may be of the same width everywhere, and in the adjustment of the bell in such wise as that the feather-edge before mentioned shall everywhere bisect, in its horizontal projection, the aforesaid annular opening.

The operation of the implement is now very manifest. The steam, when the exhaust cock into the boiler is opened, rushes up through the exhaust pipe into the chamber N, thence through the orifices O O, into the body of the cup, whence it issues through the annular opening,
impinging upon the feather-edge of the bell and setting the whole metallic mass in vibration, thus producing, according to the rapidity of those vibrations, the musical sound in question.

The vibrations appear to depend both on the actual pressure of the steam at its places of exit and impact, (in which expression the vertical height between the lip of the cup and that of the bell is involved,) and on the capacity of the bell itself. No doubt they depend also upon the circumscribing mass of the bell; but, in what relation, experiment has not yet given the means of judging. The most obvious and easy way of affecting the vibration, and thus modifying the tone of the instrument, is by doing what has been already spoken of, but can now be better understood on changing the set of the bell, i. e., by means of the screw thread at A, and the tightening nut D adjusting the feather edge nearer to or further from the annular opening.

In the sketch, the bell is represented as screwed up to its highest point, but observations were made with it at regularly successive heights from a quarter of an inch above the cup, i. e., the distance, C H or E M, brought down to 0.25 inch, onwards. A summary of these observations is presented in the following table:

<table>
<thead>
<tr>
<th>STEAM PRESSURE.</th>
<th>Height of bell.</th>
<th>NO. OF OBSERVATIONS MADE.</th>
<th>Remarks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range.</td>
<td>Mean.</td>
<td>lbs.</td>
<td>in.</td>
</tr>
<tr>
<td>lbs.</td>
<td>lbs.</td>
<td>0.25</td>
<td>0.50</td>
</tr>
<tr>
<td>20 — 51</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>21 — 52</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>21 — 49</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>25 — 57</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>40 — 68</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
</tbody>
</table>

The fourth and fifth columns are introduced here merely as an approximate indication of the effect on the intensity of the sound from the prosthema or augmented height of the bell which is registered in the third. This indication here is only accidental, and gathered from a series of experiments not instituted in this special view, which was purposely deferred. In order to derive a precise result from such special experiments, it will be of course necessary to maintain an identity of pressure throughout, and to arrange a second whistle with its bell at a constant height by the side of the other so as to obtain a standard for simultaneous comparison. In this way we can determine the effect of a given prosthema in modifying the quality, i. e., the gravity or acuteness, of the tone, and also the relative intensity or sonorosity of different tones of the same bell; and if with this we couple a systematic change
of pressures, and apply some suitable measure of the actual force of the wind at the corresponding epochs, it is possible to obtain the equivalent of either one of these elements in terms or in some function of the other, and thus anticipate and provide for the solution of a problem of no small practical importance in actual fog-signals.

As it is, however, the table given serves to show—what also agreed with my impressions at the time and before I had an opportunity of grouping and comparing the observations—that a prosthea of about 1.5 inch affords the maximum of sonorousness for a bell of the dimensions in question. And this likewise agrees nearly with the general opinion and practice—founded, I suppose, upon experience even if unsystematic—of those who are concerned in the use of these implements upon railroads.

But among these persons so concerned, I could find no opinion founded upon experience or otherwise as to the quantity of steam necessary to be supplied for working the implement in use; and this, therefore, one of the points mentioned above as essential to be known, had to be made matter of specific determination. The description of the methods used in making this determination, I shall present here as succinctly as possible; and offer it at all only because you ought to have an opportunity of judging for yourselves of the appropriateness and reliability of the several steps that have been taken, and of the soundness of the considerations upon which those steps were grounded.

The boiler used for the purpose was originally for a locomotive engine; but had been converted into a stationary one for driving machinery at the works of Mr. Winans, in this city, by whom it was placed at my disposal. The description of it and of its appliances may be materially abridged by exhibiting the accompanying longitudinal section, drawn to a scale of \( \frac{1}{8} \) of the actual dimensions.

The water gauge was a glass tube of half-inch bore, quite uniform, and divided by a scale of equal parts, each inch, numbered successively downwards, and fitted into steam-tight caps with shut-off cocks in branches with flanges to allow of being screwed on upon the face of the boiler, as shown. The boiler was then filled with water up to the level, A, of the dome; the shut-off cocks being open both above and below. And directly afterwards the water was drawn off by the ordinary discharging cocks into a vessel of known capacity, viz: 0.633 cubic feet. From the level at which the water gauge was applied it is evident that a good deal of water, all that contained in the dome and upper part of the cylindrical segment, would be discharged before the water surface in the boiler could be indicated by any of the divisions of the tube. In point of fact, the 20th bucket full showed the level of that surface at 0.10 of the scale and so onward, as is seen in the following extract from the notes made at the time.
<table>
<thead>
<tr>
<th>Buckets drawn</th>
<th>Divisions of scale</th>
<th>Cubic feet</th>
<th>Buckets drawn</th>
<th>Divisions of scale</th>
<th>Cubic feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>.................</td>
<td>12.03</td>
<td>23</td>
<td>2.875</td>
<td>14.56</td>
</tr>
<tr>
<td>20</td>
<td>0.10</td>
<td>12.63</td>
<td>24</td>
<td>3.625</td>
<td>15.19</td>
</tr>
<tr>
<td>21</td>
<td>1.10</td>
<td>13.29</td>
<td>25</td>
<td>4.50</td>
<td>15.83</td>
</tr>
<tr>
<td>22</td>
<td>2.</td>
<td>13.93</td>
<td>&amp;c.</td>
<td>&amp;c.</td>
<td>&amp;c.</td>
</tr>
</tbody>
</table>

As this extract is only given to illustrate the mode of observing, it is unnecessary to continue it through the 41 divisions observed, the last of which happened to coincide exactly with the 77th bucket drawn off, and had already descended further below the average water-line than it would be safe in practice to allow.

These irregular fractional divisions of scale can be readily converted into a unitary progression of whole numbers by a suitable interpolation applicable also in the last column, and yielding there a new series of values for capacity of boiler or steam-room. This is shown in the following table of——

**Value of divisions of water gauge in cubic feet of steam-room.**

<table>
<thead>
<tr>
<th>Division</th>
<th>Steam-room</th>
<th>Division</th>
<th>Steam-room</th>
<th>Division</th>
<th>Steam-room</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12.59</td>
<td>9</td>
<td>19.26</td>
<td>18</td>
<td>26.80</td>
</tr>
<tr>
<td>1</td>
<td>13.22</td>
<td>10</td>
<td>20.05</td>
<td>19</td>
<td>27.64</td>
</tr>
<tr>
<td>2</td>
<td>13.93</td>
<td>11</td>
<td>20.89</td>
<td>20</td>
<td>28.49</td>
</tr>
<tr>
<td>3</td>
<td>14.65</td>
<td>12</td>
<td>21.73</td>
<td>21</td>
<td>29.33</td>
</tr>
<tr>
<td>4</td>
<td>15.46</td>
<td>13</td>
<td>22.58</td>
<td>22</td>
<td>30.17</td>
</tr>
<tr>
<td>5</td>
<td>16.19</td>
<td>14</td>
<td>23.42</td>
<td>23</td>
<td>31.02</td>
</tr>
<tr>
<td>6</td>
<td>16.91</td>
<td>15</td>
<td>24.27</td>
<td>24</td>
<td>31.86</td>
</tr>
<tr>
<td>7</td>
<td>17.73</td>
<td>16</td>
<td>25.11</td>
<td>25</td>
<td>32.71</td>
</tr>
<tr>
<td>8</td>
<td>18.45</td>
<td>17</td>
<td>25.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table was in the original preparatory calculation extended through the whole range of the scale; but the divisions inscribed here are all that were actually employed, and all that need be given. The ciphers in small type are the first differences of the quantities of steam-room; and their occasional irregularity is to be attributed, I presume, to the existence of certain stay-bars inside of the boiler, which lie within the range of level where these numerical irregularities occur.

Having now the means of determining the steam-room in the boiler corresponding to any stand of water gauge, it is easy, provided the
observations can be made accurately enough, to determine the quantity of steam made between any two successive epochs of time and of water gauge. For this we need, besides, only the observation of the pressure or the temperature of the steam during the interval in question. If the volume of water evaporated during said interval be taken as unity, the volume of steam made will be represented nearly enough for practical purposes by this equation:

\[ V' = \frac{V_p}{p'} (1 + 0.002 \cdot t') \]

in which \( V \) = volume of steam at 212° F., a temperature taken as equivalent to the ordinary pressure of the atmosphere, and = 1695 when the volume of water at that temperature yielding it = 1.

\( p \) = atmospheric pressure = 15 lbs. per square inch.

\( p' \) = actual pressure observed in pounds per square inch, and if taken with the usual steam gauge to be augmented by 15 lbs.

\( t' \) = temperature corresponding to \( p' \); and

\( t = 212° \) Fahr.

\( V_p = 25425 \).

From this equation was constructed, for greater convenience, the following table, which, as it may hereafter serve in connection with the prosecution of the subject, and is not readily to be met with elsewhere, is here presented, calculated through as great a range of pressures as are at all likely to be required for fog-signals:

**Table of the pressure, temperature, and volume of steam: water evaporated being 1**

<table>
<thead>
<tr>
<th>Pressure in Pounds</th>
<th>Temperature in °Fah.</th>
<th>Volume</th>
<th>Pressure in Pounds</th>
<th>Temperature in °Fah.</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>212</td>
<td>1095</td>
<td>35</td>
<td>290.3</td>
<td>796.6</td>
</tr>
<tr>
<td>16</td>
<td>215.6</td>
<td>1006.4</td>
<td>36</td>
<td>292</td>
<td>776.9</td>
</tr>
<tr>
<td>17</td>
<td>219</td>
<td>1518.3</td>
<td>37</td>
<td>293.6</td>
<td>736.1</td>
</tr>
<tr>
<td>18</td>
<td>222</td>
<td>1468.6</td>
<td>38</td>
<td>295.3</td>
<td>740.3</td>
</tr>
<tr>
<td>19</td>
<td>225</td>
<td>1373</td>
<td>39</td>
<td>297</td>
<td>723.6</td>
</tr>
<tr>
<td>20</td>
<td>227.8</td>
<td>1316.5</td>
<td>40</td>
<td>298.5</td>
<td>767.4</td>
</tr>
<tr>
<td>21</td>
<td>230.5</td>
<td>1255.5</td>
<td>41</td>
<td>300</td>
<td>692</td>
</tr>
<tr>
<td>22</td>
<td>233</td>
<td>1208.9</td>
<td>42</td>
<td>300.3</td>
<td>677.3</td>
</tr>
<tr>
<td>23</td>
<td>235.5</td>
<td>1167.4</td>
<td>43</td>
<td>303.5</td>
<td>663.4</td>
</tr>
<tr>
<td>24</td>
<td>238</td>
<td>1118.3</td>
<td>44</td>
<td>304.5</td>
<td>650</td>
</tr>
<tr>
<td>25</td>
<td>240.4</td>
<td>1074.7</td>
<td>45</td>
<td>305</td>
<td>637.2</td>
</tr>
<tr>
<td>26</td>
<td>242.7</td>
<td>1037.9</td>
<td>46</td>
<td>277.3</td>
<td>629.4</td>
</tr>
<tr>
<td>27</td>
<td>244.8</td>
<td>1008.4</td>
<td>47</td>
<td>278.7</td>
<td>613.2</td>
</tr>
<tr>
<td>28</td>
<td>247</td>
<td>971.6</td>
<td>48</td>
<td>280</td>
<td>601.7</td>
</tr>
<tr>
<td>29</td>
<td>249</td>
<td>941.6</td>
<td>49</td>
<td>281.3</td>
<td>590.9</td>
</tr>
<tr>
<td>30</td>
<td>251</td>
<td>915.6</td>
<td>50</td>
<td>283.9</td>
<td>580.3</td>
</tr>
<tr>
<td>31</td>
<td>253</td>
<td>887.7</td>
<td>51</td>
<td>286.9</td>
<td>570.2</td>
</tr>
<tr>
<td>32</td>
<td>254.9</td>
<td>862.7</td>
<td>52</td>
<td>285.2</td>
<td>560.0</td>
</tr>
<tr>
<td>33</td>
<td>256.7</td>
<td>838.4</td>
<td>53</td>
<td>286.5</td>
<td>551.2</td>
</tr>
<tr>
<td>34</td>
<td>258.6</td>
<td>817.3</td>
<td>54</td>
<td>287.7</td>
<td>542.1</td>
</tr>
</tbody>
</table>

The next step was the attempt to measure the quantity of water evaporated during given intervals. For this the fire was got up in the boiler; and when the pressure of steam was well up, and increasing uniformly, the stand of the water and steam gauges was read, the time
noted, and the exhaust pipe leading to the steam whistle opened at the moment. After a certain interval, the steam still blowing off through the whistle, the gauges were again read; and so on through the whole series. Of these observations, an example is given in the following extract from the note book:

<table>
<thead>
<tr>
<th>Time.</th>
<th>Water gauge</th>
<th>Pressure</th>
<th>Steam-room</th>
<th>Temperature</th>
<th>Volume of steam, water = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>h. m.</td>
<td>°</td>
<td>Pounds.</td>
<td>Cubic feet.</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>11 26</td>
<td>16.5</td>
<td>40</td>
<td>25.53</td>
<td>288.9</td>
<td>533.4</td>
</tr>
<tr>
<td>11 30</td>
<td>15.5</td>
<td>31</td>
<td>26.59</td>
<td>277.3</td>
<td>624.9</td>
</tr>
<tr>
<td>11 40</td>
<td>18.5</td>
<td>33</td>
<td>27.22</td>
<td>280</td>
<td>691.7</td>
</tr>
<tr>
<td>11 45</td>
<td>19.5</td>
<td>34</td>
<td>28.91</td>
<td>281.3</td>
<td>590.9</td>
</tr>
<tr>
<td>12 10</td>
<td>21.5</td>
<td>45</td>
<td>29.75</td>
<td>294.6</td>
<td>493.8</td>
</tr>
<tr>
<td>12 15</td>
<td>24</td>
<td>50</td>
<td>31.86</td>
<td>300</td>
<td>460</td>
</tr>
</tbody>
</table>

Of these, the numbers in the first three columns alone are from direct observations; those in the last three are tabular numbers from the preceding tables. The intervals in the series, of which these form a part, were intended to be from 5 min. to 5 minutes; but it was found necessary several times to shut off the exhaust, &c., so that these observations are not regularly consecutive, but have to be taken in pairs. To illustrate the mode in which they have been applied, it will be enough to take the first pair.

The difference in the stand of the water gauge for these, viz: 1.0.5 corresponds to an evaporation of water or augmentation of steam-room, as shown in column 4, to amount of 1.27 cubic feet in the interval of 4 minutes. And if the initial pressure of 40 pounds above the atmosphere had been sensibly maintained through the whole interval, the boiler would have been making (1.27 × 533.4 = ) 677.4 cubic feet of steam, of temperature 288°.9 F., in that time. Also, the maintenance of such pressure would indicate that the exhaust was working off just the quantity supplied, and neither more nor less, while an increase of pressure would show that the supply was gaining upon the consumption, and that an accumulation of steam was taking place, and vice versa. In fact, however, we see, from the second observation, that the pressure fell during the interval, and that the initial and residual densities of the steam were in the ratio of 1 to 1; which change of density is both a consequence and a measure of the consumption. The steam made and steam consumed are inversely proportionate to the observed densities at the beginning and end of a given period, or what amounts to the same, the steam made is equal to the number of cubic feet of water evaporated during the period in question, multiplied by the volume or tabular factor of expansion corresponding to the initial pressure, while the steam consumed is equal to the same number multiplied by the expansion due to the residual pressure. Thus, for the case in question, where the boiler was making 677.4 cubic feet, at 289° F., the consumption was (1.27 × 624.9 = ) 793.6 cubic feet, at 289° F., in 4
minutes, or 198.4 cubic feet per minute, at a pressure of 40 pounds above the atmosphere. Treated in the same manner, the second pair of observations give \((1.69 \times 590.9 =) 998.5\) cubic feet, at \(280^\circ\), in 5 minutes, or 199.7 cubic feet per minute, at 33 pounds above the atmosphere; and the third pair, \((2.11 \times 460 =) 970.6\) cubic feet, at \(294^\circ 6\), in 5 minutes, or 194.12 cubic feet per minute, at 45 pounds.

Yet, accordant as these results appear to be, I could not but regard their agreement as in good measure fortunate. The device of the method was well enough, and the appliances seemed to leave little or nothing to desire; and while the boiler contained only cold water, the water gauge indicated the level within very precisely. But when it contained steam, the vapor in the upper part of the gauge condensed irregularly, and, falling down in drops, materially disturbed the accuracy of reading; so that, after a dozen and more observations, the mean of which, without regard to temperature, gave me a consumption of 219.6 cubic feet per minute, I resolved to resort to another method.

This was to measure the annular orifice through which the steam issued. It was impossible, in the nature of the case, to make this measurement directly with any reliability. But I suppose it could be done indirectly with sufficient precision by affixing the whistle, provided with a suitable stop-valve in the chamber \(N\), horizontally to a water cistern of known dimensions; allowing the water to be discharged through the annular orifice during certain periods; measuring the head of water above the centre of the orifice at the commencement and end of those periods; ascertaining thus the whole quantity of water discharged, as well as the velocity of efflux; and with these elements calculating back to the area of orifice properly corresponding.

In this view, then, upon a cistern having a rectangular surface of 3.7664 square feet, and suitably fitted, were made the following observations of particulars, and were obtained the accompanying final results:

<table>
<thead>
<tr>
<th>Period</th>
<th>Initial</th>
<th>Residual</th>
<th>Depth of the prism discharged</th>
<th>Mean velocity in feet per second</th>
<th>Area of annular orifice in square feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
<td>Inches</td>
<td>Inches</td>
<td>Inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.85</td>
<td>2.15</td>
<td>5.38311</td>
<td>0.0020977</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.90</td>
<td>2.10</td>
<td>5.38714</td>
<td>0.0020392</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.75</td>
<td>2.25</td>
<td>5.37904</td>
<td>0.0019442</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.80</td>
<td>2.20</td>
<td>5.37709</td>
<td>0.0020655</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.75</td>
<td>2.25</td>
<td>5.37904</td>
<td>0.0019449</td>
</tr>
<tr>
<td>61</td>
<td>15</td>
<td>12.70</td>
<td>2.30</td>
<td>5.36699</td>
<td>0.0021987</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.85</td>
<td>2.15</td>
<td>5.38211</td>
<td>0.0020469</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.80</td>
<td>2.20</td>
<td>5.37709</td>
<td>0.0020655</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>12.75</td>
<td>2.15</td>
<td>5.38211</td>
<td>0.0020469</td>
</tr>
</tbody>
</table>

In making the calculation of the last two columns, it was thought proper, in every case except the first two, to allow an additive correction of 1.25 seconds to the period inscribed, in order to cover the inaccuracy
that would have occurred otherwise from the mode of discharge, which was not simultaneous at the moment of beginning over the whole orifice; but, commencing first at the lowest point of the circumference, extended itself promptly, but progressively, upwards, until it embraced the whole area. This is mentioned to account for the apparent discrepancy between the area given by the 1st and that by the 8th and 10th observations.

The arithmetical mean of all the areas is 0.0020924 square feet, which may be represented nearly enough by 0.0021 square feet taken in the subsequent calculations, as the precise area of the annular opening sought.

These subsequent calculations were in applying the dimensions which had thus been obtained to the case of steam issuing through the annular orifice, and were made according to the following formula, viz: \( Q = s \cdot \sqrt{2gh} \cdot \frac{\Delta}{\delta} \) = quantity discharged per second.

In this, \( s = \) area of orifice in square feet.

\( g = \) gravity, taken at 32 feet per second.

\( H = \) height in feet of a column of water equilibrating the pressure of steam in any case.

\( \Delta = \) density of the water (or any other fluid) assumed for the manometric column; and

\( \delta = \) density corresponding of steam.

I took here water as the manometric fluid, reckoning a column 33\( \frac{1}{2} \) feet high as equivalent to a pressure of 15 pounds or 1 atmosphere, because of the convenience of using the tabular factors of expansion given on page 108 ante. Using these factors, \( \delta \) becomes equal to unity throughout; and the fraction \( \frac{\Delta}{\delta} \) equal to the appropriate factor itself.

Substituting the constant numbers in the equation, clearing them as far as possible of the radical, and observing that 60 \( Q = Q' = \) quantity discharged per minute, we have \( Q' = 60 \cdot 8 \cdot 0021 \cdot \sqrt{H\Delta} = \) cubic feet per minute. \( \therefore Q' = 1.0080 \sqrt{H\Delta} \), and finally, near enough for practical purposes, \( Q' = \frac{H\Delta}{\frac{1}{3}} = \) cubic feet of steam per minute. Applying this to an average case of 40-lb. pressure above the atmosphere, we have \( H = 2\frac{2}{3} \) atmosphere \( \times 33\frac{1}{2} \) feet = 88\( \frac{3}{8} \) and the tabular value of \( \Delta = 533.4 \) corresponding to 55-lb. pressure, and consequently \( Q' = \left(\frac{88\frac{3}{8}}{9} \cdot \frac{533.4}{2}\right) = 217.75 \) cubic feet. The direct estimation by the water gauge (p. 109 ante) gave 198.4 cubic feet.

If we take the extremest case that is likely to occur, and the utmost to which the boiler need be taxed, viz: a pressure of 75 lbs. above the atmosphere, we shall have a consumption of steam equal to 240 cubic feet per minute. The density of this steam, which is of temperature 322\( ^\circ \) 6 F., is very nearly \( \frac{1}{3} \frac{1}{3} \) that of water; and the 240 cubic feet at that temperature would require therefore the evaporation of \( \frac{2}{3} \frac{2}{3} = 0.7 \) cubic feet of water, or say 5.25 gallons per minute. For such an evaporative power, then, the grate and fire surface of the boiler should be proportioned.

In making these proportions and those of the other accessories, I procured the help of Messrs. Winans & Whistler, expert and successful
engine builders of this city; and a general design for an upright tubular boiler was arranged, of which the sketches in the margin show a vertical section through the middle and a ground plan of base. Of course, a boiler working with the pressures of steam that have been mentioned requires to be fed by a pump, and instead of a hand pump, which at even the lower pressures would be quite laborious, and would no doubt furnish an item for complaint, it was thought best to attach machinery to be worked by extra steam. This steam pump and fixtures can all be contained within the square of the base.

Such a boiler and apparatus of the general design and external dimensions as given and warranted to do the prescribed work of evaporation, the parties named will formally enter into contract to furnish complete within a month from the date of the order for the sum of twelve hundred and fifty dollars.

I omitted to state in the proper place that the smoke stack, which on the sketch is exhibited in fragment, will require to be about twenty feet in height. It might, with advantage, be even higher if the circumstances of the locality admit.

The price given is for the apparatus turned out of the shop. In addition to this cost will be the expense of transportation to the place that may be chosen for its erection, and the transport and subsistence of a workman from the shop, who would be occupied say three days in putting together these parts—pump, stack, &c.—that are better shipped separately.

I have considered the design, and besides my long-established confidence in the parties, am satisfied, upon my own convictions, of its efficiency, and also of the reasonableness of the price asked; and I therefore do not hesitate to recommend, if you, upon consideration, approve of the preliminary information that has been obtained, and the conclusions which have been arrived at, that the execution of the design be undertaken accordingly.

At the same time, I should not omit another suggestion as in this connection worthy of being considered. The boiler itself used for these experiments is now on hand, in reasonably good working order, and capable of use for a long time to come. The gratuitous use of it has been offered to me for any further experiments, at any other place, during any reasonable period. It has occurred to me that avail might be judiciously taken of this offer, either instead of the immediate construction of the new boiler, or for the purpose of some further experiments, to be spoken of presently. Either of these alternatives would promote economy, assuming that you approve of the fitness of the latter contingency. In connection with the former, it is to be considered that the existing boiler is more bulky, and nearly twice as heavy as the proposed one will be. It would, therefore, be more troublesome to remove once, (and it will require in fact two removals, one forth and the other back,) and more expensive to shelter. The weight of these considerations, however, would be very much modified by the circumstances of the locality where it might be determined to place it.

But leaving these contingencies, I pass rather to some other topics more nearly connected with the point at issue. The cost of construction
of the proposed boiler has been already given; that of its equipment and shelter will depend very much upon the judgment and taste exercised in its erection. All that is absolutely indispensable is a wooden shed to protect it from the weather. In the same shed there would be room enough for the store of fuel, if that be coal; if it be wood, there is less occasion for protecting it. Instead of having the signals made by hand, which would be tedious and dependent upon individual accuracy and fidelity, it would be proper to have the whistle valve opened at suitable intervals by machinery attached to the pump. In this way a greater regularity would be insured, and characteristic distinctions in the mots blown could be easily established. I do not know if such distinctions are as desirable here as in the case of light-signals; there would be at least this advantage of discriminating between the fog-signal and the accidental sounds from steamers, for instance, that might be in the vicinity unseen. It would not be difficult, indeed, by making the bell movable, in a vertical sense, to graduate a succession, at pleasure, of sounds in a musical scale, and thus to make the instrument, in fact, play a tune. But, even if we dispensed with this refinement as a too luxurious ingenuity, there is a certain advantage in having a succession of different notes rather than a monotone, in that with the same intensity the sound of the former is more audible. The whole expense of this equipment and shelter may be rated from fifty to two hundred and fifty dollars, according to completeness and extent.

The cost of maintenance depends very much upon the care taken in management, and upon the more or less frequent use of the apparatus. As sea water has to be used, there will be deposit and corrosion in the boiler very promptly and to a destructive extent, unless particular attention be paid to timely and frequent blowing off. With proper care, assuming that the boiler is worked for one-sixth of the year, the annual expense of repair need not transcend five per cent. of the cost, or say seventy dollars upon the boiler and machinery proper. I consider one hundred dollars as a large allowance.

The expenditure of fuel will be more considerable, and all the more because of the liberal allowance that ought to be made for blowing off, in order to spare the boiler. The average consumption in this particular may be set down at two and a half tons per day of twenty-four hours, the whistle being blown continually. In point of fact, it would be more judicious to have intervals, regularly alternating, of silence. The expenditure of fuel would also be proportionately reduced.

If there are two keepers at the light, they are sufficient for the requisite attendance, both as respects time and competency. The care of the steam apparatus demands less sedulity and not more mechanical skill in manipulation than the apparatus of a revolving Fresnel light.

There is one point in which the two concern us differ, to be sure. Carelessness about the lamp, &c., has in general no other consequence than the damage to the machinery and the diminution or extinction of the light. Carelessness about the steam apparatus may be followed by a disaster personally affecting, in limb or life, the attendants. It is probable that such a constant liability, individually, will rather increase
than diminish the reliability of the keepers, and will tend to promote
their assiduity.

With ordinary attention to the steam and water gauges, and to the
blow-off cock, the routine and contingencies of which can easily be made
the matter of a very brief and intelligible instruction, the risk of either
deficiency of steam or explosion is practically nothing. And I cannot
find in the possible abuse of this agent—steam—any argument against
its judicious and easily-manageable use for a purpose to which it is so
eminently applicable, and for the accomplishment of which it seems in-
deed to furnish the sole unquestionable resource.

A few pages back I spoke of some further experiments that were de-
sirable to be made. These do not relate to the general merits or effi-
ciency of the system of fog-signals by steam, which I consider as estab-
lished with all reasonable certainty by what has been done. They con-
cern modifications and improvements in the apparatus as now designed,
and refer principally to the effect which the form, size, mass, and set of
bell have separately or together upon its sonorousness. In this connec-
tion, too, it would be proper to try the effect of different areas of annu-
lar orifice; although, from the history of the steam-whistle, and the suc-
cessive steps of its development, I consider it highly probable that no
useful resort will be found in lessening the annular dimensions that
have been experimented on. As, however, a quite minute variation
here materially affects the quantity of steam demanded, it is possible
that a sufficient sonorousness and characteristic distinctness of tone may
be obtained with a smaller implement.

Experiments like these would already have been tried under the au-
thority presumed from your general instructions, except for the incon-
veniences of the circumstances. They would have required a removal
of the boiler, which could not until very recently have been spared, or
of some other, which could not be procured except upon conditions which
would have been extravagant, to some place without the city. As it
was, our experiments at the works were disturb- d, and I confess, not
without reason, by the interference of the municipal police. The dis-
urbances, to be sure did not amount to anything; for, in anticipation
of some such consequence from the fearful noises accompanying the ex-
periments, they were so programmatized as to allow, at various inter-
vals, of a cessation, and thus to manifest all becoming respect to the au-
thorities. But in the remaining series such intervals cannot with con-
venience and economy be allowed; and the only resort is to posit the
boiler either entirely without, or at some unpopulous place within, the
municipal limits.

As I have mentioned this subject now, I await, under the circum-
stances, your further instructions. And having thus communicated in
what precedes all that is necessary (and, I begin to fear, more than is
necessary) to a full understanding of the matter of report, I refer
the decisions to your wise discretion.

And have the honor to remain, gentlemen, with profound respect,

J. H. ALEXANDER.
Report of the Light-house Board to the Secretary of the Treasury, in answer to a resolution of the Senate of February 1, 1858, calling upon the Department for information in regard to the expense of erecting Light-houses, &c.

Treasury Department,
Office Light-house Board, March 18, 1858.

Sir: I have the honor, by direction of this board, and in compliance with the directions of the Department, respectfully to submit the following report and accompanying papers, in answer to the resolution of the Senate of the United States, calling upon the Secretary of the Treasury to communicate to the Senate the annual expense of erecting light-houses and supporting the light-house system, since the creation of the Light-house Board; and also the expense of the same number of years preceding the organization of the said board.

The period embraced in the clause of the resolution, calling for the expense of erecting light-houses and supporting the light-house system, prior to the organization of the Light-house Board, is 5½ years, viz: from the commencement of the fiscal year on July 1, 1847, to the 30th September, 1852, inclusive; and the same period of time since the organization of the Light-house Board is from October 1, 1852, to December 31, 1857, inclusive.

The table hereto appended, marked A, exhibits the number of light-houses and lighted beacons; number of light-vessels and lights on board of them; expenditures under the several heads for each year and fraction of a year; the mean average rates of cost p-r annum of the lights, and the mean annual expenditures on account of the buoy service, and the amount of commissions paid to collectors of customs acting as superintendents of lights, for the 5½ years immediately preceding the organization of the Light-house Board.

Table B is an exhibition similar to table A, for the period of 5½ years, under the management of the Light-house Board.

Table C exhibits the annual and aggregate special appropriations for new aids to navigation on the Atlantic, Gulf, and Lake coasts, and restoring old ones, for the period embraced in the resolutions of the Senate, immediately preceding the organization of the Light-house Board.

Table D is the same as table C, excepting that it embraces also the Pacific coast, and is for the period embraced in the resolution of the Senate, since the organization of the Light-house Board.

Table E exhibits the amounts and balances of special appropriations on account of new aids and renovating old ones, authorized by Congress, available for those purposes on the 1st January, 1858, and the amounts which have reverted to the surplus fund.

Table F exhibits the expenditures for the support and maintenance of light-houses and buoys on the Pacific coast of the United States, to the 31st December, 1857, under the direction of the Light-house Board.

Table G exhibits the amount of balances in the treasury and available on account of the appropriations for the support and maintenance of the
light-house establishment, at the close of the fiscal year ending June 30, 1857, and a similar list of balances to the 31st of December, 1857.

Table H exhibits a recapitulation of tables A and B, showing means of expenditures per annum and per light, for the two periods of time preceding and succeeding the organization of the Light-house Board.

To which is appended "List of Light-houses, beacons, and floating lights of the United States, in operation on the 1st July, 1851, &c., carefully revised and corrected, by order of Stephen Pleasonton, Fifth Auditor and general superintendent of lights," (marked I,) and "List of light-houses, lighted beacons, and floating lights of the United States, prepared by order of the Light-house Board; corrected to January 1, 1858," (marked J.)

From the tabulated statements embraced in these tables, it will be seen—

1. That the mean annual average cost of each light-house and lighted beacon, for the 5½ years immediately preceding the organization of the Light-house Board, the mean average cost of oil being, for the same period, $1 13½ per gallon, was $1,302.

2. That the mean average annual cost of each light-house and lighted beacon, for the 5½ years, under the management of the Light-house Board, the mean annual cost of oil for that period being $1 62½ per gallon, was $1,286.

3. That the annual average cost per light-house and lighted beacon, under the administration of the Light-house Board, has been $16 less than under the previous management for the same period of time; the difference in the average cost of the oil for illumination at the same time being $0 49¾ per gallon greater, since the organization of the Light-house Board, than for the same period immediately preceding the organization of the board.

The 325 light-houses and lighted beacons, existing at the date of the organization of the Light-house Board, could not have been classed (according to established denominations, taking their power and range into consideration, in comparison with lights elsewhere) higher than—

1 First class, or primary sea-coast light.
2 Second class, or secondary sea-coast lights.
16 Third class, or bay, sound, lake coast, &c., lights.
87 Fourth class, or bay, sound, river and harbor lights.
210 Fifth and sixth class, or river, harbor and pier-head lights.

325

Of that number (325) there were—
One first-order catadioptric or Fresnel apparatus.
Two second "    "    "    "
One third "    "    "    "
One fourth "    "    "    "

The others (320) were fitted with inferior reflectors and lamps, consuming, according to the estimates submitted to Congress for the fiscal year ending June 30, 1852, (page 65, A.) 106,365 gallons of oil per
annum, as per statement, viz: Estimates for oil, &c., for fiscal year ending 30th June, 1852.—(Estimates, page 65, A.)

"For 331 light-houses, 3,093 lamps, 35 gallons each, 108,255 galls.". From which deduct for 6 reflector lights, difference between 331 and 325, at an average of 9 lamps each, 54 lamps, at 35 gallons each.......................... 1,890 "

Making total quantity for 325 lights....................... 106,365 "

as found by the Light-house Board, according to the estimates submitted to the Department and to Congress.

Of the 320 reflector lights existing at the time of the organization of the Light-house Board, but six remain to be fitted, or the apparatus provided for them, on the catadioptric system, which apparatus do not deteriorate from use nor require to be renewed, producing, according to the experience of all countries into which they have been introduced, at least four times as much light for the benefit of the navigator as the best system of reflector lights which has been devised, and, at the same time, at a consumption of not more than one-fourth of the quantity of oil required for the best system of reflector lights.

In illustration of the comparative merits and advantages of the two systems of light-house illumination, (reflector in use prior to the organization of the Light-house Board and the catadioptric or lens system nearly completed under the management of the Light-house Board,) the following remark from a recent publication of British parliamentary papers, "On the comparative merits of the catoptric and dioptric lights for light-houses," may be cited:

"The illuminating power of the most perfect kind of lenticular apparatus of the first order and the most perfect kind of parabolic reflectors are in the ratio of at least eight to one."

In further illustration of this subject, the estimate for oil for 331 lights, submitted to Congress for the fiscal year ending June 30, 1852, was 108,255 gallons, (annual estimates, page 65, A,) and the estimates for the fiscal year ending June 30, 1853, for oil for 349 lights, was 114,520 gallons, (annual estimates, page 67, A,) which was at least one-seventh less than the actual quantity required for keeping efficient lights, with lamps and reflectors, as may be seen by referring to the excess of expenditures over appropriations, (table A, for the five and a quarter years anterior to the organization of the Light-house Board,) and from the fact that large quantities of oil were purchased and delivered to the different keepers by the superintendents, compared with the estimate for oil, (estimates for 1858-'59, page 96, A,) "for 556 light-houses and lighted beacons, 48,150" gallons, under the management of the Light-house Board.

During the last four and a quarter years the sum of $155,479 07 has been expended by the Light-house Board from the appropriations for renovations, repairs, &c., of light-houses, for the purchase of the catadioptric apparatus referred to, for the lights existing at the time the board took charge, which was rendered indispensable in executing the law of Congress, of March 3, 1851, and to render the lights efficient,
reliable, and economical. A deduction of this sum from the gross expenses for support and maintenance would reduce the average annual cost per light-house and lighted beacon, under the management of the Light-house Board, from $1,236 to $1,195, or a difference in favor of the Light-house Board's management over that of the five and a quarter years previous to its organization of $107 per annum per light, and this, too, during a period of time when the most important item of light-house consumption cost one-third more than during the previous period of time with which the comparison is made.

The cost of other supplies, materials, and labor of all kinds, reached, during the last five and a quarter years, an equally great advance over the previous period, but which has not been taken into the account.

Another element of legitimate deduction in the expense of maintenance of the light-houses, under the Light-house Board, but which has not been taken into account, is the excess of expenditures of the first quarter of the fiscal year 1852-'53, immediately preceding the organization of the Light-house Board, in proportion to the gross sum appropriated for the entire year, (table A, column one-quarter year, 1852,) is the deficiency of supplies for the then current year, rendering the purchase of 21,000 gallons of oil, at a cost of $26,000, and other supplies for the lights, indispensable; comparing this deficiency with the supplies on hand available for the service during the next fiscal year, 1858-'59, under the Light-house Board, we find that there were in store, and available for the service of the next fiscal year, at the close of the deliveries for the current year, $35,000 gallons of oil, and other necessary supplies in like proportion, which, if deducted from the gross amount of money actually expended, would greatly reduce the average annual cost.

During the existence of the Light-house Board fog-bells and other fog-signals have been authorized by Congress, including those previously authorized but not erected, amounting to $58,900; the placing of each of these bells or fog-signals involved an expense of an additional light-keeper to work it, or an increase of the salary of the keeper of the light-house at which placed, for the additional responsibility and labor incurred.

Lest it might be inferred that the condition of the towers and buildings, and the reliability and powers of the different lights at the time of the organization of the Light-house Board and at the present time were the same, it is deemed proper to recur to the number and classes, or order, of lights then and now.

<table>
<thead>
<tr>
<th>Prior to Light-house Board</th>
<th>1st order.</th>
<th>2d order.</th>
<th>3d order.</th>
<th>4th order.</th>
<th>Total.</th>
<th>1st order.</th>
<th>2d order.</th>
<th>3d order.</th>
<th>4th order.</th>
<th>5th and 6th order.</th>
<th>Total.</th>
</tr>
</thead>
<tbody>
<tr>
<td>325</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td>21</td>
<td>40</td>
<td>173</td>
<td>199</td>
<td>459*</td>
<td></td>
</tr>
</tbody>
</table>

* Of this number six require lens apparatus to be provided.
4. In table A, under the head of light-vessels, the mean annual average cost per light for the five and a quarter years prior to the organization of the Light-house Board is shown to have been $2,749.

In table B, under the head of light-vessels, the mean average annual cost per light, for the five and a quarter years under the management of the Light-house Board, is shown to be $2,796. The mean average cost of oil purchased in the first-named period (table A) being $1 13\frac{3}{80} per gallon, and in the latter, (table B,) under the Light-house Board, being $1 62\frac{1}{50} per gallon, making an excess of expenditure per light-vessel light per annum, under the management of the Light-house Board, of $47.

The aggregate amount of expenditures for support and maintenance of the light-vessels, from which the average annual cost per light is found, includes the building of four new light-vessels, to take places of old ones, and of 25 lanterns and reflector apparatus of the most approved description, for the light-vessels stationed at prominent points requiring the best lights that can be produced from light-vessels, to render the navigation of the localities safe and easy, and which expenditures were in addition to the ordinary repairs, refitments, &c., which amount in the aggregate to not less than $100,000.

Of the 34 light-vessels, containing 44 lights, existing at the time the Light-house Board took charge, there was but one of the first-class, in tonnage or power of light, occupying a primary or exposed position; six of the second-class, and the remainder, (27,) occupying unexposed positions, of small tonnage, and requiring small crews to take charge of them.

Of the 52 light-vessels, containing 72 lights, existing on December 31, 1857, under the management of the Light-house Board, there were 11 of the first-class, of 240 to 275 tons each, occupying exposed sea positions, requiring expensive outfits of anchors, cables, &c., and crews of about three times the number required by light-vessels occupying unexposed positions in bays, sounds, &c.; 12 of the second-class, and the remainder occupying unexposed positions in bays, sounds, and rivers.

Within the last five years the wages of seamen in the Navy has been increased from $12 to $18 per month, while the rates in the mercantile marine, to which the light-vessel service had mainly to look for crews, ranged at still higher figures. Rations which cost in 1852, and prior to that time, for the crews of light-vessels, from 19 to 20 cents per man per day, have averaged, during the last five years, from 25 to 35 cents per day per man. Labor and materials of all kinds for repairing light-vessels, and supplies other than oil, have advanced in proportion to the price pay for that article.

5. The mean annual average cost of the buoy and beacon service, (table A,) for the five and a quarter years immediately anterior to the organization of the Light-house Board, was $75,664 60, and for a similar period of time, under the Light-house Board, it was $82,267 13. (Table B.)

The greater economy in this branch of the Light-house Establishment Service, under the management of the Light-house Board, will be seen by referring to the fact that, prior to the organization of the board, the
6th section of the act making appropriations for light-houses, &c., approved September 28, 1850, which directs that all the buoys "shall be colored and numbered" as therein prescribed, was entirely neglected and disregarded; and that in the general appropriation bill for the support and maintenance of lights, &c., approved August 31, 1852, the first appropriation of $12,000 was made to carry out that act according to its terms.

The condition of the beacon and buoy service at the time of the organization of the Light-house Board as compared with its present state, the large increase in the number and improvements in the character of those aids to navigation, authorized by Congress to be placed since the organization of the Light-house Board, (table D, column special appropriations for buoys and beacons, amounting to $448,386 60 during the last five and a quarter years,) and disregarding the large amount of property on hand available for this branch of the light-house service, and which is indispensably necessary for its economical and efficient management, the comparison will be found to be very favorable to the last five and a quarter years.

6. In the column of table A, for the mean annual average amount paid to collectors of customs acting as superintendents of lights for the five and a quarter years anterior to the organization of the Light-house Board, will be found $9,882 11, and the aggregate amount for the same period, under the same management, (i. e., prior to the Light-house Board,) $52,358 61.

In table B, under the same heading, the mean annual amount paid was $5,529 52, and the aggregate amount paid under the management of the Light-house Board was $28,847 66, making an annual saving, under the Light-house Board, of $4,352 59, and an aggregate saving for the five and a quarter years of $23,510 95.

7. Table F exhibits the expenditures under the different heads of appropriation for the light-house service on the Pacific coast. The appropriations for that coast have been made upon estimates distinct from those for the Atlantic, Gulf, and Lake coasts, and as there were no aids on that part of the coast of the United States existing at the time of the organization of the Light-house Board, there were no prior expenses to be compared with them. The great distance from the Atlantic to that coast, and the difficulties and expenses attending the distribution of supplies to the lights there, render it necessary to keep a larger proportional supply of oil, &c., in store for future use than on the Atlantic side. The cost of labor, materials, and supplies of all kinds has been, and is yet, three to five times what it is on the Atlantic coast, while the average rate of compensation of light-house keepers has been fixed by Congress at double the rate on the Atlantic coast.

8. Table C exhibits the amounts of appropriations under the respective heads, for new aids to navigation, and for renewing old ones, made by Congress in special bills, from March 3, 1847, to August 31, 1852, and prior to the organization of the Light-house Board, amounting in the aggregate to $2,541,862 66.

Of those appropriations a number of the works remained to be com-
pleted, commenced, or condemned under the law as unnecessary, by the Light-house Board at the time it was organized.

9. Table D exhibits the amounts of appropriations, under the respective heads, for new aids to navigation and for renewing old ones, specially authorized by Congress from March 3, 1853, to March 3, 1857, and during the existence of the Light-house Board, amounting to $3,636,930 72.

Of these sums, the appropriations made respectively on the 3d of March, 1853, 1855, 1857, amounting in the aggregate to $922,467 03, were based upon estimates in the annual estimates submitted by this board, and included by the Secretary of the Treasury in the annual estimates submitted by him to Congress. Those for the years 1854 and 1856, amounting in the aggregate to $2,714,463 69, were embraced in special light-house appropriation bills, originating with the Committees on Commerce of Congress.

10. Table E shows the sum of $1,756,205 81 unexpended, including $369,597 90 carried or to be carried to the surplus fund of the treasury, and $1,356,600 63 available on account of special light-house works authorized by Congress.

11. Table G shows at the close of the last fiscal year a total balance in the treasury of $467,015 49, exclusive of sums in the hands of disbursing officers available for the support and maintenance of the light-house service during the current year, and being that amount less than the sum appropriated or available for the general service, and also a balance at the close of the half of the current fiscal year (December 31, 1857,) of $967,106 15 available for the remaining half and for the next year's service in maintaining the light-house establishment.

12. The table H is a recapitulation of the averages for the two periods of five and a quarter years each, both before and since the organization of the Light-house Board, prepared from the tables before recited.

13. The two light-house lists, July 1, 1851, and December 31, 1857, will afford a general comparative view of the service at the two periods of time, and the columns of "built," "rebuilt," "re-fitted," of the latter will show in brief what has been done towards rendering the lights efficient and reliable by the Light-house Board.

It may not be amiss to add that the light-houses, lighted beacons, and light-vessels, authorized prior (but not built) and those authorized since the organization of the Light-house Board, amount in the aggregate to near 300; permanent beacons about 80; and the buoys have been increased within the same period nearly or quite fourfold.

The Light-house Board, in submitting its estimates, for the first time, (November 10, 1852,) for the support of the light-house establishment for the fiscal year ending June 30, 1854, states, in the letter accompanying them: "The estimates of this board for the fiscal year ending June 30, 1854, are the same in every respect as those for 1852, 1853, for the same objects. The additional estimates for objects authorized by the acts of March 3, 1851, and August 31, 1852, not contained in former lists and estimates, are based upon the same data, and bear relatively the same proportion to them.

"The additional estimates submitted for objects deemed of importance
are not such as have hitherto been classed under the ordinary heads of repairs, &c., and amount in the aggregate to $27,000 less than the estimates for similar objects last year.

"For support of the light-houses and other aids to navigation on the coasts of California and Oregon, estimates are now submitted for the first time.

"The continued high prices of labor, &c., on the Pacific coast rendered it necessary that a different scale of estimating should be adopted for that coast; but in doing so the board has conformed its estimates to the most economical rates which would seem to be justified by the best information that could be obtained."

The letter of the Light-house Board of October 7, 1857, addressed to the Secretary of the Treasury, submitting estimates for the support of the light-house establishment for the fiscal year ending June 30, 1859, states:

"These estimates have been prepared to meet the actual state of the light-house service as it will be at the close of the present fiscal year, and not upon the pro rata of expenditures of previous years, as heretofore, in view of the fact that by the commencement of the next fiscal year the system of catadioptric illumination authorized by the 7th section of the act of Congress making appropriations for light-houses, &c., approved March 3, 1851, and which has been in steady progress of execution since the organization of this Board on the 9th October, 1852, will be near its full completion, which will thenceforth produce the economical results indicated at that time by greatly diminishing the annual consumption of oil, wicks, chimneys, and other supplies, as compared with that of the old system of reflectors and lamps, in addition to other benefits arising from increased brilliancy and power of the lights and from illuminating apparatus which is not liable to any sensible deterioration from use.

"The aggregate amount of estimates submitted for the fiscal year ending June 30, 1859, for the Atlantic, Gulf, and Lake coasts, is...... ........................ $712,598 99
The aggregate amount of estimates for the Pacific coast, for the fiscal year ending June 30, 1859............... 78,535 91
The aggregate amount of estimates for the fiscal year ending June 30, 1859, for the Atlantic, Gulf, Lake, and Pacific coasts, is.......................... 791,134 90

Showing a diminution of................................. 399,471 39
in the estimates for the fiscal year ending June 30, 1859."

The estimates for annual expenditures for support and maintenance of the light-house establishment, under the management of the Light-house Board, for the five fiscal years ending June 30, 1858, have been made at the same rate as that for the fiscal year ending June 30, 1853. The letters accompanying the estimates from year to year show this. In every case the existing light-houses, and those authorized to be built, were included. The object of this was to complete the renovation of
the light-houses, and their equipment with Fresnel lenses, as soon as practicable, without asking Congress for special appropriations for the purpose.

By the end of the present fiscal year that object will have been accomplished, and it will be seen, from the letter of the board, of October 7, 1857, previously quoted, that the estimates for the fiscal year ending June 30, 1859, are based upon the saving made by the introduction of the lens system, and are the first fruits of that system, so far as regards an annual diminution of the expense of the establishment, the benefits of the introduction having been felt in all other respects since its commencement. A further diminution in the estimates may confidently be expected for the fiscal year ending June 30, 1860, when it is hoped that the expenditures will be brought to the minimum.

Notwithstanding the fact that large expenditures for rebuilding light-houses and purchasing new illuminating apparatus have been made from the general fund for support and maintenance, it will appear, by a comparison of the two periods of 5½ years before and after the organization of the Light-house Board, that in the former period the expenditures overran the appropriations by $127,421 79, (a deficiency made good by transfers from special appropriation for light-houses,) while in the latter the appropriations exceeded the expenditures by $590,176 18.

Inasmuch as the subjects relating to light-houses, illumination, the management of the light-house service of this and other maritime countries, &c., were much discussed in Congress, from about 1838 to the passage of the law authorizing the organization of the Light-house Board, in 1852, for a general view of the condition of the light-house establishment prior to the latter date the board would respectfully refer to the following congressional documents, being a part only of those printed:

- Senate document No. 138, 2d session, 25th Congress.
- Senate document No. 258, 2d session, 25th Congress.
- Senate document No. 159, 2d session, 25th Congress.
- Senate document No. 506, 2d session, 25th Congress.
- Senate document No. 474, 1st session, 26th Congress.
- Senate document No. 619, 1st session, 26th Congress.
- Senate document No. 488, 1st session, 29th Congress.
- Senate executive document No. 28, 1st session, 32d Congress, pages 18 to 20, et seq.
- Senate executive document No. 22, 2d session, 32d Congress, pages 70, et seq.
- House document No. 183, 2d session, 27th Congress.
- House executive document No. 114, 1st session, 32d Congress;

And also, for a general view of the condition of the light-house service, under the management of the Light-house Board, to the several reports on the finances, submitted by the Treasury Department to Congress, for 1853-'54-'55-'56, and to the report No. 16 in the finance report of December, 1857, from page 229.
It is respectfully submitted that the foregoing report and accompanying tables show the following facts:

1. The whole system has been remodelled according to the tenor of the 7th section of the act of Congress of March 3, 1851, producing the effects contemplated by that act with regard to economy and efficiency.

2. The number of buoys, beacons, and other day-marks, has been increased by direction of Congress at least fourfold.

3. The number of light-stations, since the organization of the Light-house Board, under the authority of Congress, been nearly doubled.

4. For the imperfect lamps and lanterns previously employed new apparatus has been introduced, the most perfect in character which the science and skill of the present day are able to afford.

5. Not only has a large diminution of the amounts of oil and other supplies for lights been effected, but the extent to which the sea-coast lights are visible over the surface of the water has been greatly increased, which increase was indispensable for the safety of navigation.

6. From the combined results of these changes, the efficiency of the system has been multiplied eight times, at a nominal aggregate annual increase, the expenditures per light having been actually less than they were before the organization of the board.

7. This efficiency may be still further increased with an annual reduction of the expenditures, since the cost of the introduction of the new apparatus was much greater than that which will be required to continue its use.

Very respectfully,

W. B. SHUBRICK,
Chairman of the Light-house Board.

Thornton A. Jenkins,     W. B. Franklin,     [Secretary.]  
Hon. Howell Cobb,        Secretaries.          
                      Secretary of the Treasury.
<table>
<thead>
<tr>
<th>Year</th>
<th>Light-houses and Lighted Beacons</th>
<th>Light-vehicles</th>
<th>Buoys and Beacons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of lights</td>
<td>Rate of average annual cost per light</td>
<td>Total amount in expended for wages, repairs, and maintenance</td>
</tr>
<tr>
<td>1847-48</td>
<td>226</td>
<td>$1,220.00</td>
<td>$318,302.42</td>
</tr>
<tr>
<td>1848-49</td>
<td>157</td>
<td>$1,135.00</td>
<td>$318,302.42</td>
</tr>
<tr>
<td>1849-50</td>
<td>227</td>
<td>$1,378.00</td>
<td>$329,308.21</td>
</tr>
<tr>
<td>1850-51</td>
<td>310</td>
<td>$1,130.00</td>
<td>$368,912.81</td>
</tr>
<tr>
<td>1851-52</td>
<td>317</td>
<td>$1,313.00</td>
<td>$418,133.78</td>
</tr>
<tr>
<td>1st quarter of 1852-53</td>
<td>323</td>
<td>$1,750.00</td>
<td>$498,230.57</td>
</tr>
</tbody>
</table>

Mean annual average for 31 years:

- Total amount of expenditures for 31 years, from July 1, 1847, to September 30, 1872: $1,882,304.45
- Total amount appropriated for 31 years, from July 1, 1847, to September 30, 1872: $1,872,478.00

W. B. SHUBBICK, Chairman.

Thornton A. Jenkins, Secretary.

Treasury Department, Office Light-house Board, March 13, 1858.
### TABLE B.

**ATLANTIC, GULF, AND LAKE COASTS.**

Exhibiting the number of lighthouses and lighted beacons; rate of average annual cost of each light for supplies, repairs, keepers' salaries, and incidental expenses; total amount expended per annum for supplies, repairs, keepers' salaries, and incidental expenses of the lighthouses and lighted beacons; number of light-vessels; number of lights on board of light-vessels; average cost of support and maintenance per annum per light on board of light-vessels; total amount expended per annum for support, maintenance, and repairs of light-vessels; total amount per annum expended for buoy and beacon service; total amount of commissions paid to collectors of customs acting as superintendents of lights, etc., upon disbursements made by them for the support and maintenance of the aids to navigation; total amount expended under the foregoing heads per annum for the fire and a quarter years immediately succeeding the date of the organization of the Light-house Board in October, 1852, embracing the period from October 1, 1852, to December 31, 1857, and the rates and average paid for oil during that period.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Lighthouses</th>
<th>Rate of Average Annual Cost Per Light</th>
<th>Total Amount Expended for Supplies, Repairs, Salaries, &amp;c., of Lighthouses</th>
<th>Number of Light-vessels</th>
<th>Average Annual Cost of Repair and Support of Each Light-vessel</th>
<th>Total Amount Expended for Supplies, Repairs, Salaries, &amp;c., of Light-vessels</th>
<th>Number of Lights on Board of Light-vessels</th>
<th>Average Annual Cost Per Light on Board of Light-vessels</th>
<th>Total Amount Expended for Support, Maintenance, &amp;c., of Light-vessels</th>
<th>Number of Beacons</th>
<th>Total Amount Expended for Buoy and Beacon Service</th>
<th>Amounts Paid to Superintendents of Lights, &amp;c., for Commissions on Disbursements</th>
<th>Total Amount Expended for Support and Maintenance of the Lighthouses, Lighted Beacons, &amp;c.,</th>
<th>Average Rate Per Gallon of Oil Purchased for Each Year of the Period 1852-57, for Use of Public and Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1852-53, for three-quarters of a year</td>
<td>325</td>
<td>$755.00</td>
<td>$184,082.37</td>
<td>38</td>
<td>$2,604.68</td>
<td>47</td>
<td>$2,310.13</td>
<td>$31,604.68</td>
<td>28</td>
<td>$3,963.44</td>
<td>$32,963.44</td>
<td>38</td>
<td>$928,045.30</td>
<td>$20,028.00</td>
</tr>
<tr>
<td>1854-55</td>
<td>338</td>
<td>1,442.00</td>
<td>487,569.09</td>
<td>40</td>
<td>3,393.85</td>
<td>52</td>
<td>3,160.64</td>
<td>135,753.28</td>
<td>46</td>
<td>5,085.12</td>
<td>5,085.12</td>
<td>39</td>
<td>679,056.01</td>
<td>38.15</td>
</tr>
<tr>
<td>1855-56</td>
<td>434</td>
<td>1,442.00</td>
<td>955,070.01</td>
<td>45</td>
<td>4,246.18</td>
<td>63</td>
<td>3,192.45</td>
<td>191,078.16</td>
<td>56</td>
<td>6,272.20</td>
<td>6,272.20</td>
<td>42</td>
<td>901,428.01</td>
<td>50.00</td>
</tr>
<tr>
<td>1856-57</td>
<td>439</td>
<td>1,442.00</td>
<td>855,423.69</td>
<td>52</td>
<td>3,788.55</td>
<td>72</td>
<td>3,700.08</td>
<td>197,000.00</td>
<td>54</td>
<td>5,929.70</td>
<td>5,929.70</td>
<td>38</td>
<td>845,109.74</td>
<td>51.00</td>
</tr>
<tr>
<td>December, 1857, for one-half of a year</td>
<td>439</td>
<td>1,442.00</td>
<td>855,423.69</td>
<td>52</td>
<td>4,366.14</td>
<td>72</td>
<td>3,109.24</td>
<td>111,983.70</td>
<td>55</td>
<td>3,018.31</td>
<td>3,018.31</td>
<td>37</td>
<td>557,010.28</td>
<td>51.00</td>
</tr>
</tbody>
</table>

Mean annual average for 5½ years: 438, 1,380.00 855,920.92 45 3,743.55 65 2,738.57 188,992.84 82,267.13 5,529.52 772,347.75 1.62.11

Total amount of expenditures for 5½ years, from Oct. 1, 1852, to Dec. 31, 1857: 2,710,241.18 2,710,241.18 914,429.89 429,634.62 28,847.66 4,054,300.09

Total amount of appropriations for 5½ years, from Oct. 1, 1852, to Dec. 31, 1857: 3,131,727.05 3,131,727.05 987,271.36 463,669.81 41,808.65 4,624,476.87

Thornton A. Jenkins, Secretary.

W. B. Franklin, Secretary.

Treasury Department, Office Light-house Board, March 13, 1858.
TABLE C.

ATLANTIC, GULF, AND LAKE COASTS.

Exhibiting the amounts appropriated by Congress in special appropriation bills, reported from the Committees on Commerce, and in the general appropriation bills for light-houses at new localities, rebuilding old light-houses, light-vessels for new localities, and rebuilding light-vessels occupying old stations which required rebuilding, &c., for the five years (1847—1852) immediately preceding the organization of the Light-house Board.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>March 3, 1847</td>
<td>$521,250 00</td>
<td>$25,000 00</td>
<td>$546,250 00</td>
<td></td>
</tr>
<tr>
<td>August 12 and 14, 1848</td>
<td>252,091 90</td>
<td>64,000 00</td>
<td>316,891 90</td>
<td></td>
</tr>
<tr>
<td>March 3, 1849</td>
<td>191,441 37</td>
<td>35,407 00</td>
<td>226,848 37</td>
<td></td>
</tr>
<tr>
<td>September 28, 1850</td>
<td>422,590 00</td>
<td>8,000 00</td>
<td>430,590 00</td>
<td></td>
</tr>
<tr>
<td>March 3, 1851</td>
<td>314,432 39</td>
<td>42,500 00</td>
<td>356,932 39</td>
<td></td>
</tr>
<tr>
<td>August 31, 1852</td>
<td>495,200 00</td>
<td>130,200 00</td>
<td>625,400 00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,197,005 66</td>
<td>306,107 00</td>
<td>2,503,112 66</td>
<td></td>
</tr>
</tbody>
</table>

Thornton A. Jenkins, Secretary.
W. B. Franklin, Secretary.

Treasury Department,
Office Light-house Board, March 13, 1858.


**TABLE D.**

ATLANTIC, GULF, LAKE, AND PACIFIC COASTS.

Exhibiting the amounts of special appropriations made by Congress for erecting light-houses at new localities, rebuilding old ones, building light-vessels for new localities, &c., and for buoys, beacons, and fog-bells for new localities, and restoring those destroyed, for the five years (1852 to 1857) immediately succeeding the organization of the Light-house Board.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>March 3, 1853..........................</td>
<td>$276,250 00</td>
<td>$6,000 00</td>
<td>$43,160 00</td>
<td>$333,410 00</td>
</tr>
<tr>
<td>August 3, 1854.........................</td>
<td>1,210,338 00</td>
<td>33,500 00</td>
<td>19,600 00</td>
<td>1,563,478 00</td>
</tr>
<tr>
<td>March 3, 1855.........................</td>
<td>245,000 00</td>
<td>239,640 00</td>
<td>245,000 00</td>
<td>729,640 00</td>
</tr>
<tr>
<td>August 18, 1856.......................</td>
<td>1,054,514 15</td>
<td>42,507 54</td>
<td>113,474 00</td>
<td>1,163,505 69</td>
</tr>
<tr>
<td>March 3, 1857.........................</td>
<td>231,838 81</td>
<td>800 00</td>
<td>52,112 60</td>
<td>324,652 63</td>
</tr>
<tr>
<td></td>
<td>3,017,940 96</td>
<td>144,203 16</td>
<td>448,386 60</td>
<td>3,636,930 72</td>
</tr>
</tbody>
</table>

* To repair damages and supply losses occasioned by ice caused by storm of January 19, 1857.

W. B. SHUBRICK, Chairman.

THORNTON A. JENKINS, W. B. FRANKLIN,

Secretaries.

**TREASURY DEPARTMENT,**

*Office Light-house Board, March 13, 1858.*

---

**TABLE E.**

Exhibiting the amounts of special appropriations which were available on January 1, 1858, and of those which have reverted, or will revert, to the surplus fund, under the administration of the Light-house Board.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance on account of light-houses</td>
<td>$1,356,200 63</td>
</tr>
<tr>
<td>Balance on account of buoys and beacons</td>
<td>30,407 28</td>
</tr>
<tr>
<td>Amount carried to surplus fund</td>
<td>363,597 90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,756,205 81</strong></td>
</tr>
</tbody>
</table>

W. B. SHUBRICK, Chairman.

THORNTON A. JENKINS, W. B. FRANKLIN,

Secretaries.

**TREASURY DEPARTMENT,**

*Office Light-house Board, March 13, 1858.*
### TABLE F.

**PACIFIC COAST.**

Exhibiting the amounts expended for support and maintenance of light-houses and buoys on the Pacific coast of the United States, from the times of their first exhibition to January 1, 1858.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total amount expended for supplies, &amp;c., for light-houses</th>
<th>Total amount expended for repairs, &amp;c., of light-houses</th>
<th>Total amount expended for salaries of keepers and assistants of light-houses</th>
<th>Total amount expended for beacon and buoy service</th>
<th>Total amount expended for commissions of errand and boarding, &amp;c.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1853-54</td>
<td>$10,790 12</td>
<td>$1,974 95</td>
<td>$8,781 50</td>
<td>$1,424 00</td>
<td>$10,790 12</td>
<td>$8,849 94</td>
</tr>
<tr>
<td>1854-55</td>
<td>1,769 49</td>
<td>16,785 17</td>
<td>15,320 91</td>
<td>4,083 05</td>
<td>58,919 90</td>
<td>67,909 33</td>
</tr>
<tr>
<td>1855-56</td>
<td>31,280 29</td>
<td>6,284 45</td>
<td>13,773 09</td>
<td>6,367 90</td>
<td>$101 18</td>
<td>77,283 76</td>
</tr>
<tr>
<td>1856-57</td>
<td>50,757 14</td>
<td>11,996 22</td>
<td>9,536 27</td>
<td>1,197 86</td>
<td>113,877 40</td>
<td>113,877 40</td>
</tr>
<tr>
<td>December 31, 1857, half year</td>
<td>18,840 45</td>
<td>11,596 22</td>
<td>9,536 27</td>
<td>1,197 86</td>
<td>113,877 40</td>
<td>113,877 40</td>
</tr>
<tr>
<td><strong>Total amounts expended to December 31, 1857</strong></td>
<td><strong>113,877 40</strong></td>
<td><strong>36,540 79</strong></td>
<td><strong>42,301 77</strong></td>
<td><strong>13,072 81</strong></td>
<td>$101 18</td>
<td>205,893 95</td>
</tr>
<tr>
<td><strong>Total amounts appropriated to December 31, 1857</strong></td>
<td><strong>162,038 63</strong></td>
<td><strong>58,094 50</strong></td>
<td><strong>124,000 00</strong></td>
<td><strong>44,250 00</strong></td>
<td>2,700 00</td>
<td>391,083 13</td>
</tr>
</tbody>
</table>

Thornton A. Jenkins, Secretary.

W. B. Franklin, Secretary.

Treasury Department, Office Light-house Board, March 13, 1858.

W. B. Shubrick, Chairman.
TABLE G.

Exhibiting the balances remaining in the Treasury, under the respective heads of appropriations, for the support and maintenance of the Light-house Establishment, at the close of the fiscal year ending June 30, 1857, and also at the close of the first half of the current fiscal year ending December 31, 1857.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Balances remaining</td>
<td>$357,941 49</td>
<td>$46,372 13</td>
<td>$46,563 76</td>
<td>$2,290 96</td>
<td>$13,847 15</td>
<td>$467,015 49</td>
</tr>
<tr>
<td>June 30, 1857 .......</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balances remaining</td>
<td>678,047 29</td>
<td>153,526 87</td>
<td>114,604 19</td>
<td>2,930 33</td>
<td>17,997 47</td>
<td>967,106 15</td>
</tr>
<tr>
<td>December 31, 1857 ...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thornton A. Jenkins, Secretary.
W. B. Franklin, Secretary.

Treasury Department, Office Light-house Board, March 13, 1858.

W. B. Shubrick, Chairman.
**TABLE II.**

**RECAPITULATION.**

Exhibiting the average number of light-houses and lighted beacons, the average annual cost of each light, the average total annual expense of the light-houses and lighted beacons, average number of light-vessels, average annual cost per light-vessel, the average number of lights on board of light-vessels, the average annual cost per light, the average total annual expense of the light-vessels, the annual average expense of buoys and beacons, the average annual amounts paid to superintendents of lights for commissions on disbursements, the average total amounts of the cost of support and maintenance of the Light-house Establishment on the Atlantic, Gulf, and Lake coasts, and the average price of oil for 5½ years immediately preceding and succeeding the organization of the Light-house Board, October, 1852.

<table>
<thead>
<tr>
<th>LIGHT-HOUSES AND LIGHTED BEACONS</th>
<th>LIGHT-VESSELS</th>
<th>BUOYS, &amp;c.</th>
<th>COMMISSIONS</th>
<th>TOTAL</th>
<th>OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of lights.</td>
<td>Average annual cost per light.</td>
<td>Average amount expended for supplies, repairs, salaries, insurance, and commissions of superintendents.</td>
<td>Average number of light-vessels.</td>
<td>Average annual cost per light-vessel.</td>
<td>Average amount expended for repairs, support, &amp;c., of light-vessels.</td>
</tr>
<tr>
<td>For the 5½ years preceding the organization of the Light-house Board......</td>
<td>289</td>
<td>$1,503.00</td>
<td>$341,827.84</td>
<td>33</td>
<td>$3,456.00</td>
</tr>
<tr>
<td>For the 5½ years succeeding the organization of the Light-house Board</td>
<td>404</td>
<td>1,286.00</td>
<td>526,912.92</td>
<td>46½</td>
<td>3,743.56</td>
</tr>
</tbody>
</table>

Thornton A. Jenkins, Secretary.
W. B. Franklin, Secretary.

 Treasury Department, Office Light-house Board, March 13, 1858.

W. B. Shubrick, Chairman.
EXTRACT FROM MINUTES OF THE PROCEEDINGS OF THE LIGHT-HOUSE BOARD, OCTOBER 22, 1858.

A communication * * * from the Secretary of the Treasury, October 18, enclosing letter from Navy Department, detaching Commander T. A. Jenkins from duty as Secretary Light-house Board.

On motion, the following resolutions were unanimously adopted:

Resolved. That this Board regrets the detachment of Commander Jenkins, United States Navy, as its Naval Secretary, and presents its acknowledgments to him for the conscientious, able, and energetic manner in which he has performed his duties from the organization of the Board until the date of his detachment, a period of more than six years.

Resolved. That the Board is convinced that the complete introduction of the lens system of light-house illumination into the light-houses of the United States in the short space of six years is, in a great measure, due to the energy and perseverance of Commander Jenkins while Secretary of the Board.

Resolved. That the general improvement in the condition of all the branches of the Light-house Establishment, is evidence that the administrative duties have been performed with an ability and zeal which will reflect credit on Commander Jenkins, under whose direction, as Secretary, they have been mainly executed.

Resolved. That Commander Jenkins has the best wishes of the board for his success in the new duty to which he has been assigned.

Ordered. That the Engineer Secretary of the Board transmit a copy of these resolutions to Commander Jenkins.

JOSEPH HENRY, Chairman.

WM. B. FRANKLIN, Engineer Secretary.

---

EXTRACT FROM MINUTES OF LIGHT-HOUSE BOARD MEETING.

UNITED STATES SLOOP-OF-WAR PREBLE,

Paraguay Expedition,

Norfolk, Va., November 5, 1858.

SIR: I have had the pleasure to receive your very kind and highly valued letter of the 23d ult., accompanied by a copy of the resolutions of the Light-house Board upon my being detached from duty on that board.

Do me the favor to make my acknowledgments to the Board, at its next meeting, for the very flattering and complimentary manner in which it has been pleased to speak of my services in my humble efforts, under its directions and with the hearty and zealous co-operation of yourself, to place the aids to navigation of the United States in a state of efficiency with the smallest annual expenditure consistent with true economy.

It is very gratifying to me to know that the efforts of the Light-house Board for the last six years, to build up a Light-house Establishment worthy of the country and its commerce and creditable in every way to
those who have labored for its accomplishment, have been crowned with a success which was not anticipated at the commencement by its most sanguine friends.

I am, very respectfully, your obedient servant,

THORNTON A. JENKINS, Commander.

Capt. W. B. FRANKLIN,
Secretary Light-house Board, Washington, D. C.

[Extract.]

THE LIGHT-HOUSE AT MINOT'S LEDGE.

On Thursday, a number of gentlemen, by invitation of the collector of this port, visited in the revenue-cutter Hamilton, Captain Sturgis, the new light-house at Minot's Ledge, which is now nearly finished. Minot's Ledge lies off in the southeastern chop of Boston bay, about seventeen miles from the city. The rock, selected for the site of the light-house, is called the Outer Minot. At extreme low water an area of about 30 feet in diameter is exposed, and the highest point in the rock is about three and a half feet above the line of low water. This rock is exposed to the whole sweep of the Atlantic ocean. The rock on which the light-house is placed, is about a mile and a half from the Glades, the highest point. Within the last thirty years, ten ships, fourteen brigs, sixteen schooners, and three sloops, have been lost on these rocks; of these twenty-seven were total wrecks. The following particulars in relation to this great work will be read with interest:

The form of the light-house frame is an octagon, of twenty-five feet diameter at the base; the structure is formed of eight heavy wrought-iron piles, or shafts, placed at equal distance from each other, with one also at the centre. The piles were forged in two pieces each, and are connected together by very stout cast-iron or gun-metal couplings, the interior of which is bored, and the pile ends are turned, and secured to the sockets by means of large steel keys, passing through the piles and sockets. Above and below the joints or sockets, and connecting the middle pile with each outer pile, there extends a series of wrought-iron braces, and the outer shafts are connected together by similar braces, extending from one to the other, and thus the whole structure is tied together.

The keeper's house is octagonal in shape, and 14 feet in diameter; the uprights, or stanchions, are of cast iron, and rest upon the cap immediately over the pile heads, where they are secured with bolts and keys. These uprights are cast with double flanches, between which three-inch plank, grooved and tongued, are to be fitted horizontally; and at right angles, another series of plank is to be set on end vertically, and, together, these form the side or frame of the house; upon this frame the roof will be placed, and, finally, upon this, the lantern, or deck is placed.

The drilling of the holes for the light-house occupied the better part
of two seasons. The erection of the iron structure in place, it may be conceived, was comparatively a work of much less difficulty; and, with favorable weather, an undertaking not requiring much time.

The triangle and drilling machine was swept from the rocks twice during the first season’s operations, and the men were frequently washed from the rock, but happily no lives have been lost.

The holes were all finished on the 16th August, 1848, that is to say, 9 holes of 12 inches diameter, and 5 feet deep.

On the 4th and 5th September, six piles were erected in place, and by the 21st, the third remaining lower piles had been placed, and three of the braces belonging to that series placed also.

From the 21st September until the 7th October no landing could be effected on the rock. On that day the middle pile of the upper series was set in its place. On the 26th October the cap, or spider, a casting to rest upon the heads of the piles, to receive the dwelling-house of the keeper, and the lantern, consisting of eight arms and weighing some five tons, was hoisted partially towards its place. and on the 30th October this difficult undertaking was successfully completed, and the spider fixed in its proper position, and secured there, at an elevation of 55 feet above the top of the rock.

The Boston light being a revolving light, and the Minot being the next in order upon the coast, should be a fixed light; accordingly the apparatus ordered is of that character, and is composed of 15 brass lamps, with reflectors of 22 inches diameter in the clear, with very heavy plating of silver, and of the best description of work.

The framing of the lantern, with the exception of the posts, is of cast iron, and is a polygon of 16 faces; diameter at the angles 11 feet 6 inches, height 6½ feet, furnished with cast-iron ventilator; the glass, French plate, 44 by 24 inches, ¾ inch thick; the extent of the illumination will be two hundred and ten degrees.

Thus it will be seen that the entire height of the structure, from the surface of the rock to the top of the lantern, will be about 78 feet, and upwards of 66 above the line of the highest water.

The entire weight of the iron-work is about 70 tons; of this upwards of 40 tons is wrought iron, the residue of cast iron; the average weight of each complete shaft is about 8,200 pounds; the cast-iron couplings for connecting the upper piles with the lower are three feet long, and weigh nearly 800 pounds each; they are made of the best gun-metal; the weight of the lantern and illuminating apparatus is about 4½ tons.

Below the keeper’s house, and enclosed within the pile heads, a species of cellar or storeroom of the size of the house, is to be built, to contain oil, fuel, provisions, &c — *Boston paper*. 
A report of the Light-house Board in relation to the transfer of the Light-house Establishment to the Navy Department, as proposed in a bill now before the Senate "to reorganize the Navy Department."

MARCH 6, 1862.—Referred to the Committee on Commerce, and ordered to be printed.

TREASURY DEPARTMENT,
Office Light-house Board, February 24, 1862.

SIR: I have the honor, in compliance with the request contained in your letter of the 17th instant, to transmit herewith a report of the Light-house Board in relation to the transfer of the Light-house Establishment to the Navy Department, as proposed in a bill now before the Senate "to reorganize the Navy Department."

Very respectfully, your obedient servant,

W. B. SHUBRICK,
Chairman Light-house Board.

Hon. S. P. CHASE, Secretary of the Treasury.

TREASURY DEPARTMENT, February 17, 1862.

SIR: A bill "to reorganize the Navy Department" has been reported to the Senate, the effect of which, if it becomes law, will be to transfer to the Navy Department the duties and functions of the Light-house Board.

I desire your opinion as to the expediency of such transfer, and will thank you to report any facts within the knowledge of the board which will, in your opinion, contribute to a clear understanding of the whole subject.

I am, very respectfully,

S. P. CHASE,
Secretary of the Treasury.

Com. Wm. B. SHUBRICK, U. S. N.,
Chairman Light-house Board.

Report of the Light-house Board on the proposed transfer of the lights to the Navy Department

It is not necessary to dwell upon the importance of a well-organized and well-conducted system of coast lights. It is a duty which every civilized nation owes to humanity to establish and maintain such a system as will furnish the mariner with the means by which, in the hour of darkness and of peril, he may be directed to a secure and friendly harbor. It is also a duty which every enlightened government owes to its own citizens, to facilitate as much as possible the approaches to its coast, and thus advance the interests of commerce by lessening the risk of the interchange of its own with foreign commodities. This is a matter which does not alone concern the ship-owner, but is of interest to the whole community; to every one who consumes an article of
foreign production, or who has an article of domestic industry to dispose of.

But the establishment and maintenance of an efficient system of lights along an extended seacoast is a work of immense magnitude and difficulty. It requires an organization disbursing hundreds of thousands of dollars annually, and directing operations at many points thousands of miles separated from each other. To be efficient, it requires the combined knowledge and skill which the science and mechanism of the day can furnish. It requires, in the various directing agents by which it is carried on, a practical knowledge of facts and details which cannot be verbally transmitted to others, and can only be acquired by long familiarity and laborious study.

It is not enough that lights should simply be exhibited at different points along the coast; it is necessary that these should be of a particular character, such as to produce the best effect, both in regard to efficiency and economy, which the latest discoveries in science and inventions in art can furnish. But this branch of practical science, like most others, is constantly receiving improvements, and these should be adopted in all cases to which they are applicable, and where new lights are established.

A coast light for the guidance of the sailor must be such as to be easily recognized, or not readily confounded with any other, and always to be seen when its indications are required. A change in either of these respects may give a false signal which, instead of conducing to safety, would be the deceptive guide to danger.

A coast light should possess the greatest amount of penetrating power, in order that it may be seen, even in a thick night, at the furthest verge of the horizon. To be able to observe a light even a half mile further, in many cases may be of incalculable moment, for on that additional amount of offing the lives of hundreds may depend.

Again: since under the most favorable circumstances the production of an efficient coast light is an expensive operation, a system should be adopted which will give the greatest amount and intensity of light with the least consumption of material.

The least economical and efficient light for coast service is a torch or simple candle. This is very wasteful of combustible material, since it sends beams in every direction—to the ground beneath, the zenith above, and to the interior of the land as well as towards the sea.

An improvement on this consists in adding reflectors, by which the light which otherwise would be lost in passing to the land side is thrown towards the sea, and this is rendered still more efficient by combining a large number of reflectors on a frame, each with a separate light, and causing the whole to revolve together around a vertical axis, so that a broad beam of light is made to sweep the horizon at regular intervals.

This plan, although a great advance upon what had preceded it, was still very defective. The light, it is true, was very much increased in quantity, but not as much in intensity or penetrating power.

Besides this, such perfection could not be given to the mirrors as to prevent them from losing a large amount of light by scattering the rays,
and such a polish could not be kept upon them as to prevent the absorption instead of the reflection of a large portion of the incident light.

The reflecting system as a whole has therefore, in its turn, been abandoned by nearly all the civilized nations of the world, and in its place the refracting apparatus of lenses and prisms of glass, known as the Fresnel system, has been substituted. In this apparatus not only is the light economized, and the effect increased by sending it more perfectly in the required direction, but its intensity or penetrating power is also much enhanced by the employment of a mechanical lamp with concentric wicks, which enables the combustion to take place under a high temperature, and thus increases the intensity of emission.

The establishment of the light-house system of the United States, in its origin, was placed exclusively upon the ground of a necessary aid to commerce, which Congress alone was authorized to regulate with foreign nations and among the States. It had no connection with the Navy on the coast any more than it had with the lakes, where no naval vessel had ever floated, and from which even now they are almost entirely excluded. And now, if we look at the commercial marine in our foreign and coastwise trade, and upon our lakes and rivers, aided by lights, (including all their trips,) the number compared with the naval marine must be as one to a thousand. The cargoes of this commercial marine thus aided must exceed one thousand millions of dollars per annum, and nearly all our revenue heretofore collected has been collected on cargoes brought into our ports by vessels guided into our harbors and along our coast by these lights.

The proper application of a vertical system of lights requires, as we have said, an organization which can only be completed after much experience, and which demands a combination of knowledge and skill not possessed by any one individual.

The selection of proper places for light-houses on our sea-coast requires a minute knowledge of every portion of the coast, such as no person can so well possess as the head of the coast survey; the construction of the edifices on the most approved plans can with safety be intrusted only to an officer of the engineer corps; the general directions to sailors and the manning of light-vessels, the placing and equipment of light-vessels, beacons, and sea-marks, and the general management of a large part of the office duty, require the experience of a naval officer; the testing of oils, the consideration of the various propositions for the substitution of new sources of light, for improvements in the optical apparatus, in the acoustic arrangements of fog-signals, all require, for their safe discussion, thorough scientific training, such as is possessed only by those who have devoted their lives to studies of this character—who properly appreciate every real discovery, and who are best qualified to avoid, on the one hand, expensive and impracticable schemes, and on the other undue adherence to fixed ideas. To insure the cautious and economical expenditure of a large amount of money demands the watchful care and responsibility of a number of gentlemen of high professional standing.

On these accounts the light-house establishment of France, which has been brought to the greatest degree of perfection, and has served as a
model to other nations of the world, is placed under the charge of a
mixed board of military and naval officers and of scientific civilians.

This system, as well as those of Great Britain and other chief coun-
tries of Europe, had been examined, by direction of Hon. R. J. Walker,
Secretary of the Treasury, by Lieutenants Jenkins and Bache, United
States Navy, whose able report was before the Department as a guide in
proposed reforms.

It was in accordance with the same considerations that a commission
was appointed in 1851 to examine into the light-house establishment of
the United States; of which much complaint had been made. The light-
house establishment at that date was under the charge of the Fifth
Auditor of the Treasury, with such temporary assistants as from time to
time he was able to call to his aid.

From what has been stated it must be evident that even had this officer
no other duties to perform, yet it could not be otherwise than that the
establishment would be far behind that which the wants of commerce
and of humanity demanded, and accordingly the commission, after
minute inspection of the system, reported a series of imperfections and
omissions, which Congress sought to remedy by the appointment of the
present Light-house Board.

The board consists of "two officers of the Navy of high rank, one offi-
cer of the corps of engineers of the Army, one officer of the corps of
topographical engineers of the Army, and two civilians of high scientific
attainments, whose services may be at the disposal of the President,
and an officer of the Navy and an officer of engineers of the Army as
secretaries."

This board is properly placed under the direction of the Secretary
of the Treasury, since its object is the promotion of commerce, the
legitimate duty of this officer, and since it is only under a neutral de-
partment that the members of the Army and Navy can harmoniously
co-operate. Upon the Lakes there is almost no naval force.

Of this board the Secretary of the Treasury is president, and one of the
members is chairman. It meets every month, and oftener, as business
may require. During the intervals of the meetings of the board the
daily routine business is carried on by the secretaries and a number of
clers, with frequent consultations with the Secretary of the Treasury
and the chairman of the board.

All bids for purchases and constructions are opened in the presence
of the board and of the bidders themselves, when they choose to attend.
All propositions presented to the board are referred to one or other of
the following committees:

Committee on finance; committee on light-vessels; committee on en-
gineering, (construction of buildings;) committee on lighting; committee
on experiments.

Reports from these committees upon the subjects referred to them
are made at the several meetings. A journal of all the proceedings is
kept, and all matters of importance are fully discussed before being
acted upon.

Comparatively few changes have taken place in the board since its
organization, except among the younger members who have been re-
moved from Washington on public duty. Four out of the original six members are still connected with the establishment, besides one of the secretaries, though the service of these officers has not been continuous: important duties connected with the naval and military operations of the country having been performed by them in addition to their service upon the Light-house Board.

Under the direction of the board all the coasts of the United States including those of the Atlantic, Pacific, Gulf, and Lakes, have been divided into twelve districts, each being assigned to the charge of an inspector, detailed from the Army or Navy for this purpose. In addition to these inspectors, officers of one or other of the engineer corps of the Army are, on application of the board, detailed from time to time to take charge of the construction of new, and the renovation and improvement of old, light-house structures.

This has been found an important feature of the light-house organization, since it has materially diminished the expense while it has improved the efficiency of the establishment.

An elaborate code of regulations and instructions, approved by the Secretary of the Treasury, has been adopted for the direction of the whole establishment, including the board, engineers, inspectors, keepers, &c.

Under this organization an entire change has been made in the whole light-house system, as will be seen by the following comparison of its condition before the appointment of the board and at the present time. In the left-hand column of the following statement are given some of the conclusions to which the provisional board, or commission previously referred to, arrived from personal inspection, or from the evidence of experienced navigators, &c., and in the right-hand column the condition of the establishment immediately prior to the breaking out of the rebellion:

Prior to 1852.

1. That the light-houses, light-vessels, beacons, and buoys, and their accessories, in the United States, are not as efficient as the interests of commerce, navigation, and humanity demand; and that they do not compare favorably with similar aids to navigation in Europe in general, but especially with those of France and Great Britain and their dependencies.

2. That the light-house establishment of the United States does not compare favorably in economy with those of Great Britain and France.

3. That the towers and buildings have not been constructed in general of the best materials, nor under the care and supervision of competent or faithful engineers.

4. That the want of professional knowledge of the materials, mortars, cements, &c., for construction and repairs, or faithfulness on the part of those charged with the duty, was apparent in nearly all the modern towers and buildings visited by the board.

Subsequent to 1852.

1. The light-houses, light-vessels, beacons, and buoys, and their accessories, in the United States, are as efficient as the interests of commerce, navigation, and humanity require, and they compare favorably with similar aids to navigation in France and Great Britain—these being the best in Europe.

2. The light-house system does now compare favorably in economy, as well as in efficiency, with the systems of Great Britain and France.

3. The towers and buildings are now constructed of suitable and of the best materials, under the care of faithful and competent engineers.

4. That the knowledge of these engineers has remedied the defects in regard to mortars, cements, &c., in recent structures.
Prior to 1852.

5. That the present large sums annually required for renewing, renovating, and repairing towers and buildings, are the consequences of the want of an efficient organization, which could afford the necessary professional ability for plans, drawings, and superintending of constructions and repairs.

6. That the towers are deficient in the necessary proper accommodations for oil and other supplies; in the mode of fitting them up, and in the materials employed for the interior work, and the buildings ill adapted to the comfortable accommodation of the keepers.

7. That the lanterns are, as a general rule, of improper dimensions, constructed of ill-adapted, and, in the end, not economical materials, without professional or scientific skill, and, in many instances, not suited to the use for which they are designed.

8. That there is no proper system of ventilation for lanterns. That the means said to be employed for ventilating are wholly inadequate, and contrary to scientific principles.

9. That, under a well-organized system, the lights, and other aids to navigation, might be greatly increased in number and efficiency, at a large saving upon the present annual cost.

10. That there has never been an efficient, systematic plan of construction, illumination, inspection, and superintendence of lights, &c., in the United States.

11. That the light-house towers, buildings, and vessels visited by the board were not, in general, found to be in a creditable state of preservation and repair.

12. That the inferiority of illuminating apparatus in the light-houses of the United States renders its renewal frequently necessary, at great expense, and never produces as effective a light as it is capable of making.

13. That the reflector apparatus employed in the light-houses of the United States is greatly inferior to the requirements of the service, being defective in form, materials, and finish. That the illuminating apparatus in the United States is of a description now nearly obsolete throughout all maritime countries, where the best apparatus of that description was employed prior to the introduction of the Fresnel lenses as substituttes.

14. That the sea-coast lights are deficient in proper attendance, with only one keeper.

Subsequent to 1852.

5. Plans, drawings, and efficient superintendence of repairs have become the rule.

6. The necessary accommodations for oil and supplies are furnished by these plans, and comfortable though plain accommodations provided for the keepers.

7. The lanterns are of proper shape, dimensions, materials, &c., and adapted to the use intended.

8. The ventilation is cared for and adequate.

9. The number of lights has been greatly increased—from 325 in 1852, to 556 in 1858, at a diminished cost—the saving in the year 1858 being $184,720.

10. There is now a systematic plan of construction, illumination, inspection, and superintendence of lights on all the coasts of the United States.

11. Timely repairs are provided.

12. Superior illuminating apparatus, requiring almost no repairs, have been provided.

13. The obsolete reflector lights have been replaced by lens lights of excellent form, material, and finish.

14. The lights have been provided with an adequate number of keepers, though the sums expended for salaries are less per light than before the board took charge of the matter.
Prior to 1852.

15. That there is no proper classification of lights in the United States.
16. That the lights are not properly and sufficiently well distinguished along the coast of the United States.
17. That there is no system of public inspection and superintendence calculated to render the light-house establishment moderately useful or efficient.
18. That the lanterns, illuminating apparatus, &c., are not superintended while they are being made by competent or faithful professional men.
19. That there are no general or special regulations for keepers and others connected with light-houses, by which to insure an intelligent or faithful performance of the duties.
20. That supplies of all kinds, involving the good or bad quality of the lights to a great extent, are not tested and selected by competent persons before issuing them to light-keepers.
21. That there is not a proper degree of responsibility on the part of the agents connected with the light-house establishment.
22. That the present mode of procuring and distributing supplies, apparatus, &c., is not calculated to insure either efficiency or economy in the service.
23. That contractors are not held under a sufficiently rigid superintendence and inspection during the execution of works of construction and repair.
24. That the modern light-house towers are inferior in point of materials and workmanship to the older ones visited by the board; such, for example, as Sandy Hook light-house, built in 1762; Cape Henlopen tower, built in 1794; Cape Henry tower, built in 1791.
25. That the floating lights of the United States are comparatively useless for want of efficient lamps and parabolic reflectors.
26. That the light-vessels are, in general, not adapted to the service they are required to perform, being defective in size, model, and moorings.
27. That the light-vessels are not properly distinguished either by day or by night.
28. That there is no effective system by which to afford to sparsely-settled parts of the coasts requiring lights the means of bringing the subject before Congress, and deciding in advance of appropriations the best descriptions of lights to be placed at the desired points.

Subsequent to 1852.

15. The lights have been duly and perfectly classified.
16. And have proper distinctions to enable the mariner to recognize them.
17. Inspectors from the Army and Navy have been provided for the light-house districts, making the system very effective.
18. The inspectors are competent professional supervisors.
19. Minute general and special regulations have been drawn up for keepers and others, securing, in combination with explanations and examinations of the inspectors, intelligent and faithful performance of duty.
20. All supplies are carefully and thoroughly tested by competent and faithful persons.
21. Special pains have been taken to insure proper responsibility by agents.
22. The new modes of procuring and distributing supplies have insured efficiency and economy.
23. The superintendence by the engineer secretary, or constructing engineers, of contractors, has led to a great reform in construction and repairs.
24. The new light-houses will challenge competition with the best structures at home or abroad.
25. Efficient lamps and reflectors have been supplied to the floating lights.
26. The best models have been procured for light-vessels and the most approved moorings.
27. Suitable distinctions by day and night have been provided for the light-vessels.
28. An elaborate system of examinations of sites has been provided, through the Coast Survey, on the Atlantic, Gulf, and Pacific, and the Topographical bureau, on the lakes.
29. That many of the small lights have an unnecessary number of lamps and reflectors, while sea-coast lights are greatly deficient in them.

30. That there is not, in useful effect, a single first-class light on the coast of the United States.

31. That there are very few, if any, reflector lights on the coast of the United States better in useful effect than the third-order lens light (larger model) erected by the topographical bureau on Brandywine shoal, while the economy of the lens light is in the ratio of at least 4 to 1.

32. That the Fresnel lens is greatly superior to any other mode of lighthouse illumination, and in point of economy is nearly four times as advantageous as the best system of reflectors and Argand lamps.

33. That the buoys in the waters of the United States are defective in size, shape, and distinction, as a general rule, and that sufficient care is not taken nor competent persons employed to place, moor, and replace them.

34. That the moorings of buoys are not sufficiently heavy, and the chains not properly tested as to size and strength.

35. That the dangerous obstructions to navigation around Cape Florida, from the Gulf of Mexico, are not properly lighted and otherwise marked to aid navigators.

36. That, for want of an efficient organization, there is no systematic plan adopted on any part of the coast of the United States for rendering navigation safe and easy by means of lights, beacons, buoys, &c.

37. That the approaches to some of our principal and most important harbors, bays, &c., are not sufficiently lighted and marked to render steam navigation as rapid, easy, and safe as the wants of commerce demand, especially to New York, Delaware, and Chesapeake bays, and some of their tributaries.

38. That the duty of lighting and marking with beacons, buoys, and sea-marks, our extended sea, lake, gulf, bay, sound, and river coast, efficiently and economically, can only be performed by persons of professional experience and undoubted ability upon a systematic plan, based upon the principles of the most approved light-house engineering.

29. The power of the lights is adapted to the requirements of their position.

30. Twenty-six first-class lens lights have been provided at the points requiring them.

31. Several lights have been established much superior in power to the best lights which existed before the board took charge of the lighting.

32. The improved Fresnel lens has been supplied to all the light-houses, and with the efficiency and economy formerly asserted.

33. Buoys of suitable size, shape, and distinction have been planned and manufactured, and are moored, placed, and replaced, by competent persons.

34. Heavier moorings and stronger chains have been supplied.

35. The dangerous reefs of the Florida coast have been supplied with lights, beacons, and sea-marks.

36. The lights, beacons, sea-marks, &c., are placed according to system on the coast, generally adapted in special places to the wants of these localities.

37. The special wants to New York, Delaware, and Chesapeake bays, &c., which existed, have been supplied, so that entering and leaving our harbors is comparatively easy.

38. The lighting and marking with beacons, buoys, and sea-marks our extended sea, lake, gulf, bay, sound, and river coast is now performed by officers of the engineers of the Army, and by officers of the Navy and by the Coast Survey.
Prior to 1852.

39. That there is no efficient system of inspection and superintendence of lights in the United States.

40. That the supplies of oil, chimney, wicks, &c., are not tested and selected with sufficient care, or by competent or faithful agents.
   That there is no proper system of distributing the supplies to light-keepers.
   That proper attention is not given to purchasing and distributing supplies.

41. That there is no system in the management of the Light-house Establishment of the United States.

42. That the instructions to light-keepers to light, trim, and extinguish the lights at certain specified times are not enforced, to the detriment of the service, and to the imminent risk of endangering vessels in their vicinity.

43. That such knowledge is not imparted to light-keepers, as a general rule, to enable them to keep their lamps, burners, reflectors, and lanterns in such order as to insure the best lights from the existing apparatus.

44. That frequent and rigid inspections and superintendence by competent persons are necessary to insure an efficient and economical light-house service.

45. That supplies are not delivered at sufficiently short intervals of time to lights.

46. That the present mode of repairing illuminating apparatus, oil tanks, &c., is not economical, efficient, or reliable.

47. That the removal, and replacing of light-vessels, the extinguishment or lighting of lights, removal or placing of buoys, &c., or in any manner changing lights and other aids to navigation, without giving ample notice, are subjects of grave complaint.

48. That there is no good reason why the light-vessels on the coasts of the United States (if properly constructed and moored) should not remain at their moorings under as unfavorable circumstances as those on the coasts of England and Ireland.

49. That whenever light-vessels are reported to have parted their moorings, the circumstances attending them should be carefully investigated by competent and disinterested persons, and the result made known.

Subsequent to 1852.

39. Each inspection district is provided with an officer of the Army or Navy to superintend it as a rule. In the temporary exigency now existing the clerks of the inspectors act for their former principals.

40. Supplies are carefully tested before being distributed, and are systematically distributed, and great care is taken in their purchase.

41. System and order, as a general rule, exist in every part of the establishment.

42. These instructions are fully enforced

43. The inspectors and other agents of the board give great attention to instructing the keepers who need it.

44. Rigid inspections are made frequently by the district inspectors and others.

45. The delivery of supplies is frequent, regular, and systematic.

46. The supply vessel has among its employees the persons necessary to make small repairs.

47. Notices are given in advance in the public papers and by printed circulars posted in the different custom-houses to which masters of vessels must repair for clearance. They are sent also to the observatory for distribution to naval vessels.

48. Rigid responsibility for keeping the positions of the light-vessels under their command is exacted from the masters.

49. This is thoroughly done.
Prior to 1852.

50. That light-house construction, illumination, inspection, and superintendence involve a large amount of special and general professional knowledge of a high character, and therefore should only be intrusted to the most competent professional persons.

51. That competent engineers have not been employed, except in a few instances, to plan and superintend the construction and fitting up of the light-houses of the United States.

52. That the large amounts required annually to repair and keep in good order the towers, buildings, vessels, and illuminating apparatus of the lights in the United States is attributable to the manner in which the work was executed, and to the inferiority of the materials employed.

53. That changes are constantly taking place in the aids to navigation, without any official notice being given to the public of them, which are calculated to mislead mariners.

54. That there is no proper system of beaconage and buoyage, nor any list by which the navigator, who is not familiar with the coast, can derive any benefit.

55. That the list of light-vessels is defective in many respects, and it at present affords very little information to the navigator, and is in some respects erroneous.

56. That there is no regular, systematic, or effective mode of giving notice to mariners of proposed changes in lights, &c., or of any that may have been destroyed or removed by the action of the sea or winds.

57. That the buoys are not properly painted according to law, nor are they in other respects properly distinguished one from another.

58. That light-houses and light-vessels are not sufficiently well distinguished by day.

59. That the buoys are not properly placed, nor replaced when driven from their positions, and without delay.

60. That spare buoys are essential for all harbors and rivers, in sufficient numbers to allow for all casualties, and for painting, &c., &c.

61. That there is no code or manual of instructions to guide light-keepers and others connected with the light service in the performance of their duties in this country, as is found in every well-regulated light-house establishment elsewhere.

Subsequent to 1852.

50. This knowledge is secured by the professional attainments of the members of the Light-house Board, and of the officers of the Navy and engineers employed as inspectors and constructors.

51. The plans are prepared by the engineer secretary, under advice of the committee on engineering, and adopted after examination by the board.

52. The repairs required for the new structures are moderate.

53. Notice is given in advance in the public prints of every intended change, either by the board or by the light-house inspectors.

54. The system of beacons and buoys is complete, and the list also.

55. The lists are complete and published annually for distribution to masters and owners of vessels and others interested in navigation.

56. Such notices are given in the public papers, and also by circulars posted in the custom-houses to which masters of vessels must resort to obtain their clearances. Circulars are sent to the observatory for distribution to naval vessels.

57. The buoys were colored as required by law soon after the board took charge of the system, and are, as a rule, kept painted.

58. Distinctive coloring has been provided for light-houses and light-vessels as day-marks.

59. Great care is taken as to the position of buoys and replacing them when the position is accidentally changed.

60. Spare buoys are provided at all important points.

61. A manual has been prepared from the experience abroad and at home, and has been printed and distributed to light-keepers.
In February, 1828, a resolution of the Senate called upon the Secretary of the Treasury to communicate the annual expense of erecting light-houses, and supporting the light-house system since the creation of the Light-house Board, and also the expense of the same number of years preceding the organization of the board. This call embraced a period of five and a quarter years. Elaborate tables were prepared, showing the number of light-houses and lighted beacons, of lighted vessels and lights on board of them, with annual and average cost, the cost of the buoy service, commissions of collectors of customs, &c., for five and a quarter years before and after the organization of the Light-house Board; the special appropriations for new light-houses and other aids to navigation, and for renovating old ones, for lighting the Pacific coast, and maintaining the lights and buoys there; the balances of appropriations and the amounts which reverted to the surplus fund of the treasury, with other particulars, including a list of light-houses, beacons, and floating lights, under charge of the Fifth Auditor of the Treasury in 1851, and under the Light-house Board in 1858.

From the tables the following results are derived, which will show how the duties intrusted to the board have been performed:

1. The mean annual average cost of each light-house and lighted beacon for the five and a quarter years preceding the organization of the Light-house Board was $1,302; the price of oil for illumination being $1.13 per gallon.

2. The corresponding cost for five and a quarter years after the organization of the board was $1,236; the cost of the oil being $1.62.
3. This shows an absolute economy of sixteen dollars per light. Of $1,302 the cost per light prior to 1851, $350 was paid for oil at $1 13 per gallon. Had there been no economy in oil, when the price per gallon rose to $1 62, each light would have cost $1.474. The actual cost of $1,280 shows an economy of $188 per light, or a reduction of expense in the proportion of 1 to 0.87, or an economy of thirteen per cent.

4. At the date of the organization of the Light-house Board there were 325 lights, consuming 106,365 gallons of oil.

There were in 1858 556 lights, consuming but 48,150 gallons of oil. The absolute economy is 58,215 gallons of oil, or, taking the increase in the number of lights into consideration, 114,925 gallons, which, at $1 62 per gallon, is an actual saving in money of $184,720 in one year.

5. In 1858 the reform of the system, by which the obsolete reflector lights have been exchanged for lens lights, had been made except in six cases. The reform was complete when the rebellion broke out. The quantity of oil required for the lights is between one-fourth and one-fifth of the quantity required for the reflector lights, while the light on the average is nearly fourfold.

6. The lenses having been purchased from the appropriations for renovations, repairs, &c., at a cost of $155,479; if this sum be deducted from the appropriations as properly chargeable to the change of system, but not to the system when reformed, the average cost of one light-house, under the management of the board, would be reduced from $1,286 to $1,195, making a difference, in comparison with the old system, of $97 per light, or of 59,492 for 556 lights and lighted beacons per annum, and this, though oil had increased in cost from $1 13 to $1 62, or about one-third, and the cost of other supplies, materials, and labor of all kinds had similarly advanced.

7. Another legitimate deduction from the apparent cost of the system under the board is the supply of 21,000 gallons of oil, costing $26,000, to make good the deficiency for the then current year when the transfer was made. The management of the board should be further credited with 35,000 gallons of oil saved at the close of the next fiscal year; the board having adopted as their estimates those of the previous fiscal year, in order to be safe as to supplies. These two savings amount to $69,000.

8. The aggregate reductions amount to no less than $244,212, comparing the years 1851 and 1858, and $69,000 as between 1851 and 1852.

9. Fog-bells and fog-signals have been erected where required, and the pay of the additional keepers thus rendered necessary is included in the annual cost of the lights.

That the board has not been extravagant in reference to this expenditure, it may be stated that the amount expended for these purposes was less by 58,900 than the appropriations made by Congress.

10. The following table shows the character of the lights under the old and new systems:
11. The apparent average annual cost of one floating light on board of a light-vessel, for the five and a quarter years prior to the organization of the board, was $2,749, and subsequent thereto, $2,796; the average cost of oil being, during the first period, $1 13, and during the second, $1 62. The number of vessels had been increased from 46 to 62. As the floating-light system is one of reflectors, the economy shown in the lights upon the land from the lens system does not occur.

The apparent balance against the board is more than turned by a full consideration of the subject.

First, the increase in the price of oil reduces the difference to thirty-one dollars.

Next, the aggregate from which the averages are deduced contains an item of not less than $100,000, paid for the building of four new light-vessels to take the place of the old ones, and the fitting them with new lanterns and reflectors. This, divided among 62 lights, gives $1,613 per light, and reduces the cost per light to the low figure of $1,183, and, unless there are corresponding deductions to be made on the other side, turns the balance very much in favor of the board.

This, however, is probably the case.

The wages of seamen have been much increased, those of the Navy receiving $18, instead of $12, and in the mercantile marine the wages being much higher. Labor and materials of all kinds have increased in cost.

12. No proper comparison can be made of the cost of the buoy service, as its conditions were lamentably defective before 1852, and is now quite complete. The law requiring the coloring and numbering of buoys was neglected before the system passed into the control of the Light-house Board, so that an appropriation of $12,000 was required in 1852 to enable the board to execute the terms of the law.

Appropriations for buoys and beacons essential to the safety of navigation had been made in 1858, amounting to $448,386—a sum by no means chargeable to the permanent system.

In no one item has there been greater improvement than in this useful accessory of the buoys. The increased cost per annum of $6,603 does not weigh at all against the advantages derived from the new system, and is more than made up in the savings from the next item, viz: the compensation of collectors.

13. The compensation of collectors for superintendence of lights, prior to 1852, was, for five and a quarter years, $52,358, when subsequently it was but $23,510 for the same period.

14. For the special appropriations made by Congress, without the recommendation of the Light-house Board, we should hardly be held
responsible. Of the amount thus appropriated in 1854 and 1856—viz: $2,714,464—$1,756,206 remained unexpended in 1858. The amount included in the annual estimates of the board, approved by the Secretary of the Treasury, for 1853, ’55, and ’57, was $922,487. The amount appropriated by Congress, under the old regime, for five and a quarter years, was $2,541,862.

If we charge against the board all these appropriations, and suppose no part of the balance remaining unexpended in 1858 to be expended subsequently, the means available for new aids to navigation and for renovating old ones would amount to $1,880,725, less by $661,187 than for the same period of the old system. If we suppose one-third of the balance remaining in 1858 to be subsequently used, there would be in favor of the board a balance of $75,736.

15. The aggregate estimates for the Atlantic, Gulf, and Pacific coasts, which were, for the fiscal year ending June 30, 1858, $1,190,606, were reduced, in 1859, to $791,134; presenting an absolute economy of $399,471 in that one year.

16. This is the first year of the full effect of the lens system, the renovation being nearly complete in 1859.

17. The expenditures for rebuilding light-houses and purchasing new illuminating apparatus, for five and a quarter years prior to 1852, exceeded the appropriation by $127,421, and subsequent to 1852 fell short of the appropriation by $590,176.

In concluding their special report of 1858, the board present the following deductions from their tables and discussions:

1. The whole system has been remodelled according to the tenor of the 7th section of the act of Congress of March 3, 1851, producing the effects contemplated by that act with regard to economy and efficiency.

2. The number of buoys, beacons, and other day-marks, has been increased, by direction of Congress, at least fourfold.

3. The number of light-stations, since the organization of the Lighthouse Board, has, under the authority of Congress, been nearly doubled.

4. For the imperfect lamps and lanterns previously employed, new apparatus has been introduced, the most perfect in character which the science and skill of the present day are able to afford.

5. Not only has a large diminution of the amounts of oil and other supplies for lights been effected, but the extent to which the sea-coast lights are visible over the surface of the water has been greatly increased, which increase was indispensable for the safety of navigation.

6. From the combined results of these changes the efficiency of the system has been multiplied eight times.

7. This efficiency may be still further increased with an annual reduction of the expenditure, since the cost of the introduction of the new apparatus was much greater than that which will be required to continue its use.

It would be highly satisfactory to the board were they allowed time to present the statistics of their expenditures and results up to the time of the rebellion, and their efforts since to supply the lights extinguished and the buoys removed by the insurgents. In this hasty report they have been obliged to recur to statistics already collected.
Another item of reduction of expenditure is the introduction of colza
or rape-seed oil.

The Light-house Board took measures early after their organization
for the introduction of this material. There are several plants the
seeds of which yield colza oil, and which are adapted to the culture in
our northern and northwestern States. Among these is the wild cab-
bage, (Brassicaoleracea,) a quantity of the seed of which was imported
by the board and distributed directly by it and through the Patent
Office. In 1861, 5,000 gallons of this oil, the product of our soil, were
purchased at a cost of $1.10 per gallon, and used in the light-houses
of the lakes. It bore the tests applied to spermaceti oil perfectly, and
no complaint whatever has been heard of it. This year 2,000 gallons
of colza oil have been offered and accepted at one dollar per gallon, and
10,000 gallons at $1.10; thus furnishing the whole supply needed for
the lights of the lakes, saving the transportation of the oil from the
sea-coast, the bids being from Wisconsin, the State where the plant is
grown and the oil manufactured, and also saving upon the cost of each
gallon nearly fifty-six cents—the average price of sperm oil being $1.64½
per gallon. This encouragement to a new branch of agriculture and
manufactures is therefore a source of economy. The board has shown
in several reports the advantage of colza oil for purposes of illumination.
The objection made to it in 1851, that it rapidly deteriorated by time
and exposure, is entirely unfounded—a fact which the board can now
state from their own experience.

It is expected by the agriculturists of the northwest that they will be
able in a few years to supply all the oil required by the light-houses and
light-vessels of the United States.

That the members of the Light-house Board have not arrogated to
themselves undue credit in the services they have rendered, they may
be allowed to state that while engaged in these labors the board has had
with them the active sympathy and support of many distinguished men,
at home and abroad, familiar with this subject, alike interesting to the
head as one of science, and to the heart as one of philanthropy. Among
these no one is more conspicuous than the very distinguished Secretary
of the Light-house Board of France, the brother of the inventor of the
lens system, who has devoted his life to the service of his country in
connection with the lights of its coast, and who, having aided the early
efforts to introduce order out of chaos in the American system, has
steadily followed up in detail the result of the changes introduced into
the organization of our establishment and into the mode of lighting.
In a letter to Commander Thornton A. Jenkins, Secretary of the Light-
house Board, dated May 7, 1861, Leonor Fresnel thus expressed his
convictions in reference to our system of lighting, and to the character
of our Government, which he naturally looks at in their connection, since
rebellion made war upon the lights and beacons of our coast, as it did
upon the fabric of our Union:

"So soon as I was sufficiently restored to health, I perused the im-
portant documents which you sent me, being attracted particularly by
the chapters in relation to the light-house service. The prodigious
development of this service within so short a time under the Light-
house Board has truly astonished me. My old experience, in fact, enables me the better to appreciate how much energy and activity were necessary to bring to this degree of perfection the light-house service of such a vast expanse of coast—as well on the Pacific as on the Atlantic—without mentioning the task of succeeding in establishing, against hostile prejudices, the adoption of a new system. Much is due to you, sir, and to your honorable co-laborers, for having created in so short a time this magnificent and combined establishment, and you should congratulate yourself that, thanks to your activity, the Union, wherein is strength, and which I find now so fatally compromised by the blindest passions, has not been overthrown before the accomplishment of your philanthropic work. I hope, however, that reason will yet triumph over these retrograde ideas, and that Providence will listen to the prayers of all generous hearts by maintaining the most admirable political structure which has ever been erected by the genius of liberty."

The board submits that the manner in which their duty has been performed in working out in so short a time a total reform of the light-house system deserved the approval of the Government. Mariners are satisfied with the condition of the lights, light-vessels, beacons, buoys, sea-marks, and other accessories of the system, so that a complaint is seldom heard, and when made is at once investigated, redressed, and any real defects at once remedied.

To place this system under one person, the board is of opinion, would not conduce to efficiency or economy, for reasons already stated, nor would the transfer to a department only incidentally interested in the service be, in our judgment, conducive to the public interest, especially the transfer to a department borne down already by the cares of its own appropriate service.

It should be distinctly remembered, on the economical side, that the members of the board serve gratuitously, no extra pay being received by any of them.

In conclusion the board respectfully suggest that so far from seeing any reason why the proposed change should be made, they see many causes to apprehend that such a change would derange the present system, diminish its efficiency, and increase the expense.

1. The light-house establishment is intended principally to promote the commerce of the United States, and is consequently appropriately placed in charge of the Secretary of the Treasury, who has the direction of all other operations connected with this branch of the executive duty of the government.

2. The officers of the Navy and Army can best and most harmoniously co-operate under a neutral department like that of the Treasury.

3. We do not hesitate to say that no officer of the Army or Navy possesses in himself the requisite amount of knowledge to properly direct all this service, and that he would be obliged to depend upon the advice and assistance of irresponsible agents; that although a proper person might acquire in time the requisite information, yet this would be at the expense of dear-bought experience, and that a recurrence of changes, such as is proposed, would deprive the system of all stability, and
introduce a vacillating policy alike detrimental to efficiency and economy.

4. With regard to economy of superintendence there can certainly be gained nothing on this score, since the members of the board receive no extra compensation for their services, the officers of the Army and Navy being employed upon it in the intervals of other duties.

5. The object of the establishment of the board was not merely to reform the system, but also for the purpose of keeping it constantly in active working operation, and for the adoption of such improvements as might from time to time be required. Its work is, therefore, a constantly recurring one. For example, light-boats are very expensive, and these should be replaced by light-houses in all cases wherever it can be done. Where light-boats cannot be replaced by light-houses, experiments should be made to ascertain whether it is possible to introduce a more economical method of lighting than that employed. Experiments should also be made on the use of kerosene and petroleum oils, &c. These subjects all require the continuance of the combined resources and experience of the board. Routine, and not improvement, would become the order of the day under one person.

6. Above all, at the present time, they consider that the proposed change would be highly detrimental to the service, since 125 lights, many of them of great importance, have been unlawfully extinguished on the southern coasts, which it will doubtless be necessary soon to re-establish, at a large expense of labor and money, and with the application of all the knowledge and experience which the board has during the past years of its existence been able to acquire.

7. The withdrawal of additional officers of the Navy from their duties afloat at the present time, when civilians are largely employed in our ships-of-war, would, it is submitted, be disadvantageous to the government.

8. Officers of the Navy cannot now be had as inspectors. The temporary arrangement made by the board, and explained in this report, is an economical one, and provides for the return to arrangements of a permanent character whenever the present exigency ceases.

9. Whatever necessary expenditures are now incurred for inspection and clerical services must be incurred under the new arrangement; and nothing warrants the idea of greater economy in the Navy Department than in the Treasury, nor of greater economy by a naval chief of a bureau than by the Light-house Board, while the board has all the experience needed to manage the peculiarly difficult circumstances now existing and in the future.

10. The chairman and secretary of the board are naval officers, serving without extra pay, and have all the experience which a new head of a bureau would want.

11. Finally, the board cannot be deemed unduly sensitive in feeling somewhat unpleasantly the implied want of confidence in their labors by the proposition submitted to Congress.

They have taken a deep interest in the development and maintenance of the system, to which they have devoted ten years of time and labor, without any other reward than the gratification which flows from the
knowledge of having faithfully, and, as they believe, efficiently, discharged their duty, and from the consciousness of having been deemed worthy of responsibilities of such high importance, both in regard to the monetary interest of the country and the cause of humanity in general.

Adopted unanimously at a meeting of the Light-House Board, at which were present Commodore Shubrick, United States Navy, chairman; General J. G. Totten, chief engineer; Major A. A. Humphreys, United States topographical engineers; Professor Bache, Superintendt Coast Survey; Professor Henry, Secretary of the Smithsonian Institution.


The Chairman announced to the board the death of Major General Joseph G. Totten, one of its members. Whereupon, it was—

Ordered, That Professor Bache be requested to prepare resolutions, to be submitted at the next meeting, expressive of the sense of the board of the great loss sustained by the public service in the death of that distinguished officer.

W. B. SHUBRICK, Chairman.

B. U. KEYSER, Chief Clerk.


Professor Bache, in compliance with the resolution passed at the previous meeting, submitted the following resolutions, expressive of the sense of the board of the loss sustained by the public service in the death of General Totten, which were unanimously adopted, viz:

Resolved, That the members of the Light-house Board feel most deeply the loss sustained by the branch of the public service under their charge, in the death of Brevet Major General Joseph Gilbert Totten, who has been one of the most useful and active members of the board, from its first appointment in pursuance of law in 1851, under the Secretary of the Treasury, as a temporary board of inquiry into the Light-house Establishment of the United States, through all the years of organization of the Establishment, and of the executive duties.

Resolved, That the high scientific attainments, the admirable administrative qualities, the perfect knowledge of general principles, and attention to every minute detail of the system, impressed the mental and moral qualities of General Totten upon his associates, in a way to make his mind eminently a leading one of the board, while his suavity, patience, perfect amiability, and retiring modesty, rendered him one of the most charming of associates in executing work, to which he was so much more than sufficient.
Resolved, That in the discharge of the duties of inquiry of the first board, the resulting organization, the adoption of the present system of lighting by lenses, the subject of construction, theoretical and practical, and the use of materials, the experience and experimental knowledge of General Totten were of the highest value to the board, and his careful applications of the sciences were of the greatest importance to the light-house system, and that in the large qualities of common sense in all the transactions of the board, constantly felt the support of General Totten as one to be relied upon for guidance in all difficult questions of administration.

Resolved, That the affectionate qualities of General Totten's heart so endeared him to his colleagues, that, in now expressing themselves in regard to his death, they are fully prepared to share to the utmost the deep grief of his family, to whom they offer their sincere condolence for the loss of one not to be replaced, but to be ever mourned as the true, devoted, and sincere friend.

Resolved, That a copy of these resolutions be transmitted to the family of General Totten, and to the Honorable Secretary of War, and to the Honorable Secretary of the Treasury.

Resolved further, That these proceedings be published in the Washington newspapers.

My Dear Friends: I am instructed by the Light-house Board to forward to the family of your lamented father, the enclosed resolutions. The board has not able to find language at all expressive of its feelings on this occasion. It has lost a guiding light in its deliberations, a pillar of support in its decisions, and each member a wise, sympathizing, loving friend. I dare not touch on the loss of those to whom he was nearer and dearer; they have the rich consolation arising from the knowledge that their grief is shared by all to whom their beloved one was known, in any of the relations of a long and useful life. With a heart overflowing with sympathy, I am your faithful friend,

W. B. SHUBRICK.

My Dear Friend: Friend of my beloved father, I can find no words to express the feelings of a heart, which is full of thankfulness for your friendly sympathy, and appreciate deeply the kind and beautiful tribute to my noble father's talents, character, and heart, and to his precious memory, expressed through you by the Light-house Board, to us, his afflicted children. Receive our thanks, and believe me, yours affectionately,

(Signed)

GRACE STEVENS.

On motion, the board adjourned.

W. B. SHUBRICK, Chairman.

B. U. Keyser, Chief Clerk.

65 L H P
EXTRACT FROM THE MINUTES OF PROCEEDINGS OF THE LIGHT-HOUSE BOARD.

SATURDAY, FEBRUARY 23, 1867.

The board met pursuant to call.
Present: Professor Henry, General Bache, General Delafield, Admiral Stribling, and the two Secretaries.
Professor Henry was called to the chair.
The minutes of the proceedings of the previous meeting were read and approved.
The Chairman pro tempore called the attention of the board to the duty of taking into consideration appropriate action in reference to the death of their distinguished and beloved associate, Professor Alexander Dallas Bache.
The following resolutions were offered as expressive of the sense of the board:
Resolved, That the board has learned with profound sorrow of the death of Professor Alexander Dallas Bache, one of the oldest and most valued members.
Resolved, That in him the board has lost a wise and sagacious counsellor, whose intimate knowledge of the coast and the consequent requirements of commerce, gained through years of patient study, peculiarly fitted him to form intelligent and useful opinions upon questions relating to changes in old and establishment of new aids to navigation.
Resolved, That the Light-house Establishment in its present organization, and the existing efficient system of lights and buoys, is greatly indebted to the services of Professor Bache as a member of the preliminary board of 1851.
Resolved, That the military education of Professor Bache, and the discriminative character of his mind, rendered of great value his opinions upon the varied questions coming before the Light-house Board, and that his general scientific acquirements were of much importance in the consideration of proposed improvements.
Resolved, That the high standing of Professor Bache for moral and intellectual endowments added influence and reputation to the board through his membership, and that in his personal character, his kindly and genial disposition, his nice sense on all occasions of propriety and justice, he endeared himself to every member of the board, and that they each lament his loss as that of a cherished personal friend.
Resolved, That the members of the board attend his funeral and wear the usual badge of mourning for thirty days.
Resolved, That a copy of these proceedings be transmitted to the family of the deceased and be published in the newspapers of the day.

JOSEPH HENRY, Chairman.

A. A. Harwood, { Secretaries.
O. M. Poe,
ORGANIZATION OF THE UNITED STATES LIGHT-HOUSE BOARD, UNDER AUTHORITY OF THE ACT OF CONGRESS APPROVED AUGUST 31, 1852, FROM OCTOBER 9, 1852, TO 1871.

EX-OFFICIO PRESIDENTS OF THE BOARD:
Hon. Thomas Corwin, Secretary of the Treasury, October 9, 1852.
Hon. James Guthrie, Secretary of the Treasury, March, 1853.
Hon. Howell Cobb, Secretary of the Treasury, March, 1857.
Hon. Philip Frank Thomas, Secretary of the Treasury, January, 1861.
Hon. John A. Dix, Secretary of the Treasury, February, 1861.
Hon. Salmon P. Chase, Secretary of the Treasury, March, 1861.
Hon. William Pitt Fessenden, Secretary of the Treasury, 1864.
Hon. H. McCulloch, Secretary of the Treasury, 1865.
Hon. George S. Boutwell, Secretary of the Treasury, March, 1869.

MEMBERS:
Commodore Wm. B. Shubrick, U. S. N., elected Chairman, October 9, 1852.
Brevet Brigadier General Joseph G. Totten, U. S. Corps of Engineers, died April, 1864.
Commander S. F. Dupont, U. S. Navy, detached from duty on the Light-house Board, April, 1857.
Lieutenant Colonel James Kearney, U. S. Corps of Topographical Engineers, detached from duty on Light-house Board, April, 1856.
Major A. A. Humphreys, U. S. Corps of Topographical Engineers, from April 1856 to 1860.
Professor Alexander Dallas Bache, LL. D., &c., Superintendent U. S. Coast Survey, died February, 1867.
Professor Joseph Henry, LL. D., &c., Secretary of the Smithsonian Institution.
Lieutenant Thornton A. Jenkins, U. S. Navy, Naval Secretary, detached from duty on Light-house Board, October, 1858.
Captain Edmund L. F. Hardcastle, of the U. S. Corps of Topographical Engineers, Engineer Secretary, detached from duty on Light-house Board, April, 1856.
Lieutenant John G. Parke, of the U. S. Corps of Topographical Engineers, Engineer Secretary, from April, 1856, to March, 1857.
Captain William B. Franklin, of the U. S. Corps of Topographical Engineers, Engineer Secretary from March, 1857, to November, 1859.
Commander R. Sennex, U. S. Navy, Naval Secretary from October, 1858, to February, 1861.
Captain William F. Smith, of the U. S. Corps of Topographical Engineers, Engineer Secretary from November, 1859, to 1861.
Commander Samuel Barron, U. S. Navy, April, 1857, to 1859.
Commander Thornton A. Jenkins, U. S. Navy, from February 11, 1861, to 1862, Naval Secretary.
Commander George F. Emmons, U. S. Navy, from May 6, 1861, to October 18, 1861.
Commodore Charles Henry Davis, U. S. Navy, from December 4, 1862, to August 15, 1866.
Commodore C. K. Stribling, U. S. Navy, from April 12, 1862, to November 7, 1862.
Rear-Admiral C. K. Stribling, U. S. N., August 15, 1866.
Major A. H. Bowman, U. S. Corps Engineers, 1858.
Colonel and Brevet Brigadier General Hartman Bache, U. S. Corps of Engineers, from 1862 to 1870.
Brevet Major General Richard Delafield, Chief of Corps of Engineers, 1864 to 1870.
Commodore Andrew A. Harwood, U. S. Navy, from 1864 to 1869, Naval Secretary.
Brevet Brigadier General O. M. Poe, U. S. Corps of Engineers, July 14, 1865, to 1870, Engineer Secretary.
Commodore Thornton A. Jenkins, U. S. Navy, April, 1869, Naval Secretary.
Professor Benjamin Peirce, LL. D., &c., Superintendent U. S. Coast Survey, 1867.
Brevet Major General A. A. Humphreys, Chief of Corps of Engineers, 1870.
Major George H. Elliot, U. S. Corps of Engineers, 1870, Engineer Secretary.

LIGHT-HOUSE BOARD OF THE UNITED STATES, ORGANIZED IN CONFORMITY TO THE ACT OF CONGRESS APPROVED AUGUST 31, 1852, ON JULY 1, 1871.

LIST OF MEMBERS:
Hon. George S. Boutwell, Secretary of the Treasury, ex-officio President.
Rear-Admiral W. B. Shubrick, U. S. Navy.
Professor Joseph Henry, LL. D., Secretary Smithsonian Institution.
Brevet Major General A. A. Humphreys, Chief of Engineers, U. S. Army.
Professor B. Pierce, LL. D., Superintendent Coast Survey.
Rear-Admiral Thornton A. Jenkins, U. S. Navy.
Major George H. Elliot, Corps of Engineers, U. S. Army.

MEMBERS OF THE BOARD EMPLOYED IN THE OFFICE:
Rear-Admiral W. B. Shubrick, U. S. Navy, Chairman.
Rear-Admiral Thornton A. Jenkins, U. S. Navy, Naval Secretary.
Major George H. Elliot, Corps of Engineers, Engineer Secretary, U. S. Army.
Report of the President of the Light-house Board, in relation to re-establishing the light-houses at Cape Florida, Jupiter Inlet and Cape Canaveral.

JANUARY 12, 1866.—Ordered to be printed.

TREASURY DEPARTMENT,
Office of the Light-house Board,
Washington, December 19, 1865.

SIR: I have the honor to state that the communication of the Senate Committee on Commerce, transmitting petition of insurance companies at New York for speedy action upon the part of Congress in the matter of appropriations for re-establishing the light-houses at Cape Florida, Jupiter Inlet, and Cape Canaveral, having been referred to the Light-house Board for report, the following is respectfully submitted:

Cape Florida.—This light will be re-established within a very short time. The necessary materials and laborers will sail from the north within a few days.

Jupiter Inlet.—The board has sent an agent to Key West, who is instructed to examine into the condition of this light-station. As soon as his report is received, the necessary steps will be taken to re-exhibit the light.

For the foregoing works the necessary appropriations are estimated for as deficiencies under the head "to enable the Light-house Board to re-establish," &c. They were contained in the bill which failed to pass Congress at the close of the last session. It is hoped that these appropriations will be made as soon as possible. The lights, however, will be re-established in anticipation of the action of Congress.

Cape Canaveral.—It is designed to erect at this station a new iron structure, a special appropriation for which is now available. The work is under contract, and is in a forward state, and will be pushed to completion as rapidly as possible.

The board fully concurs in the petitioners' estimate of the value of these light-houses to commerce, and it has constantly kept in view the necessity for their re-establishment, as well as of all others along the southern coast, endeavoring to re-exhibit the lights as fast as notified by the military authorities that they would be protected. It was not until the close of the war that those in question fell permanently under the control of the board.

Very respectfully,

W. B. SHUBRICK, Chairman.

Hon. Hugh McCulloch,
Secretary of the Treasury.

BOOKS AND PUBLIC DOCUMENTS FOR REFERENCE.

The following works, reports, and documents, may be consulted upon the subject of light-houses, viz:

Stevenson's Account of the Bell Rock light-house: Edinburgh, 1824.
Mémoire sur un nouveau système d'éclairage des Phares; par M. A.
Fresnel, Ingénier au Corps Royal des Ponts et Chaussées, &c., Paris, 1822.

Belidor, Architecture Hydraulique, tome iv, p. 151.


Fanal di Salvore, nell’Istria, illuminato a gaz: Vienna, 1821.


Saggio di osservazione, or observations on the means of improving the construction of light-houses; with an appendix, on the application of gas to light-houses. By the Chevalier G. Aldini: Milan, 1823.

Bordier Marct, Notice descriptif d’un fanal à double aspect, &c.: Paris, 1823.


Description Sommaire des Phares et Fanaux allumés sur les côtes de France: Paris, 1845.

Stevenson’s British Pharos: Leith, 1831.

The Light-houses of the British Islands, corrected at the admiralty, to October, 1844.


Clauses and Conditions relatives à la fourniture, pendant trois années, de l’huile de colza nécessaire au service de l’éclairage des Phares et Fanaux des côtes de la Manche, 1839.

Detail estimatif de la dépense annuelle de la fourniture en huile de colza nécessaire au service de l’éclairage des Phares et Fanaux des côtes de la Manche: Paris, 1839.


Sous détails du prix des diverses fournitures et des dépenses à faire pour le service de l’éclairage des Phares et Fanaux des côtes de France, 1838.
Notice sur la composition et les prix des Phares Lenticulaires, Catoptriques et Catadioptiques, parties optique et mécanique, par Léourneau et Cie., successeurs de MM. Soliel père, et François, jeune, constructeurs de Phares dioptriques, système de M. A. Fresnel, Rue des Poissonsiers No. 24, près et hors la barrière Poissonnière, à Paris.


Report by a Committee of the Board to the Commissioners of the Northern Light-houses, on the Report of the Select Committee: Edinburgh, 1836.

Report to the Commissioners of the Northern Light-houses on the illumination of Light-houses, by Alan Stevenson, M. A.: Edinburgh, 1834.

Report to the same board, on the Inchkeith Dioptric Light, by Alan Stevenson: Edinburgh, 1835.


Report on the Isle of May Light, by a Committee of the Royal Society, (Professor Forbes, reporter:) Édimbourg, 1836.


Note sur l'Appareil Catadioptrique exécutée par M. François, jeune, pour le Phare Ecossais de Scherivore: Commissaires MM. Arago, Mathieu, Babinet.

Captain Denham, R. N., Mersey and Dee Navigation: Liverpool, 1840.


Circular: Phares et Fanaux; Contrôle des consommations en huile et de la situation des divers approvisionnements: Paris, le 17 Mars, 1845.


Document H. R., 2d session 25th Congress, No. 27.


Document Senate, 2d session 25th Congress, No. 159.

Document Senate, 2d session 25th Congress, No. 428.

Document Senate, 2d session 25th Congress, No. 375.

Document Senate, 2d session 25th Congress, No. 506.

Document Senate, 2d session 25th Congress, No. 258.
Document Senate, 1st session 26th Congress, No. 474.
Document Senate, 1st session 26th Congress, No. 619.
Document H. R., 2d session 27th Congress, No. 140.
Document H. R., 2d session 27th Congress, No. 274.
Document H. R., 3d session 27th Congress, No. 199.
Document H. R., 1st session 28th Congress, No. 38.
Document Senate, 2d session 28th Congress, No. 166.
Document Senate, 3d session 25th Congress, No. 190.
Document Senate, 2d session 27th Congress, No. 983.
Document Senate, 1st session 26th Congress, No. 58.
Document Senate, 2d session 25th Congress, No. 189.
Document Senate, 2d session 25th Congress, No. 254.
Document Senate, 2d session 25th Congress, No. 15.
Memoir of Colonel B. Ayerigg, on the Light-houses at Barfleur and Ostend: Document H. R., No. 190, 3d session 25th Congress.
Captain Cotton's History of the Trinity House, London.
Edinburgh Review, No. cxxiii., vol. 61, p. 117.
Nautical Magazine, vols. 1 to 15, (1832 to 1846.)
Report of the Franklin Institute on the Dioptic System of Augustin Fresnel for the illumination of Light-houses. (Journal Franklin Institute, 1849, 1850.)
Ex. Document, 1st session 30th Congress, No. 27.
Ex. Document, special session Senate, No. 1.
Instruction pour le service des Phares lenticulaires, Paris, 1848.
An account of the cast-iron light-house tower on Gibbe' Hill on the
Bermudas; by Peter Paterson : London, 1850.
An account of the construction and fitting up of the new light-house
on the Moro castle at Havana, island of Cuba; first order lens apparatu-
( Franklin Institute Journal, July, 1847.)
Returns to Parliament of Northern lights for 1844, 1845, 1846, 1847,
1848, 1849, and 1850.
Returns to Parliament of British Colonial lights for 1846, 1849,
1850, and 1851: London.
Returns to Parliament of Trinity House Corporation lights for 1844,
1845, 1847, and 1848.
Returns to Parliament of Irish lights for 1846 and 1848.
Returns relating to the use of colza oil in Great Britain three ca-
hiers, 1846.
Cast-iron light-houses, Nautical Magazine, June, 1850.
Light-house economy, Nautical Magazine, May, 1851.
Light-houses of the British colonies and possessions abroad; by Al-
William Herschel on reflection of light from surfaces of speculum
An account of the construction and price of lenticular sea-lights;
catoptric and catadioptric, optical and mechanical portions: W. Wil-
kins, London, 1851.
Traité elementaire de Physique, par E. Péclet: Paris, 1847.
Memoir upon the lighting of the coasts of France, by M. L. Rey-
naud, &c., 1864, and translation by Rear-Admiral Thornton A. Jenkins,
U. S. N., 1871.
Portfolio and specifications of the U. S. Light-house Board, Wash-
ington City.
Laws, rules, and regulations; instructions and directions to keepers,
&c., U. S. Light-house Establishment, Washington City.
FOG SIGNALS

Elevation

Two Conoids of Parabolic Curvature for throwing a horizontal plane of Sound from a Whistle or other Instrument.

Plan.
FOG SIGNALS

Section

Revolving Paraboloids for throwing Sound from a Whistle or other Instrument all round

Plan
DABOLL'S AIR-WHISTLE

Hand-power Machine for Light-Vessels, &c.

Isometrical View.
DABOLL'S AIR-WHISTLE
Hand-power Machine for Light Vessels, &c.

Fig. 2
Sectional View.
Divided through ill Fig. 1, showing internal arrangement of Pumps for condensing air into receiver A Fig. 2.
- P- Pumps, V.V. Valves. - O.D. Springs to keep valves closed.
- W- Piston Rod. - G- Piston. - R- Guides. - S- Whistle. L- Lever to open valve D
W- Fly Wheel, supported by stand J. J- Crank for driving Pumps
M- Connections. B- Crank for operating Machine.
The whole constructed substantially of wrought iron, cast iron and brass.

Fig. 3
Brass tongue Trumpet, or Horn, composed of Brass, Copper or Tin.
A- Trumpet or Horn. B- Tongue, or need Screw to connect Trumpet or Horn to Machine.
DABOLL'S AIR WHISTLE
for Horse Power.
DABOLL'S AIR WHISTLE
for Horse Power.
## INDEX

to

REPORTS, PAPERS, &c., RELATING TO LIGHT-HOUSEES, ILLUMINATING APPARATUS, FOG-SIGNALS, &c.

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absecon inlet, description of</td>
<td>58</td>
</tr>
<tr>
<td>Absecon inlet, report against the erection of a light-house at</td>
<td>58</td>
</tr>
<tr>
<td>Absecon light, not sufficient range</td>
<td>659</td>
</tr>
<tr>
<td>Absecon, near Great Egg Harbor, 1st-order lens proposed for a light-house at</td>
<td>711</td>
</tr>
<tr>
<td>Act, an, for establishment and support of light-houses, beacons, &amp;c., 1789</td>
<td>3</td>
</tr>
<tr>
<td>Act creating the Light-House Board</td>
<td>909</td>
</tr>
<tr>
<td>Acts inconsistent with act August 31, 1852, repealed</td>
<td>902</td>
</tr>
<tr>
<td>Affidavit of D. Bryant, in relation to bad construction of Nauset Beach light-houses</td>
<td>360</td>
</tr>
<tr>
<td>Agreement, articles of, in relation to patent rights of Winslow Lewis, &amp;c.</td>
<td>5</td>
</tr>
<tr>
<td>Alarm bell for lamps, description of</td>
<td>534</td>
</tr>
<tr>
<td>Alcatraz Island light-house, California, contract for</td>
<td>867</td>
</tr>
<tr>
<td>Alligator shoal, Florida, beacon at, needed</td>
<td>794</td>
</tr>
<tr>
<td>Alterations and improvements recommended in first district</td>
<td>198</td>
</tr>
<tr>
<td>Alterations in characteristics of light-houses, should be published six months before</td>
<td>352</td>
</tr>
<tr>
<td>Alterations of lights and new lights, lighted without giving public notices</td>
<td>99</td>
</tr>
<tr>
<td>Amelia Island light-house, report about removing of</td>
<td>534</td>
</tr>
<tr>
<td>Amelia Island light-house, requires higher elevation and 1st-order lens</td>
<td>711</td>
</tr>
<tr>
<td>American and English lights, comparison of the cost of</td>
<td>879</td>
</tr>
<tr>
<td>American shoal, Florida, beacon at, needed</td>
<td>794</td>
</tr>
<tr>
<td>Amounts for light-houses, &amp;c., special appropriation bills</td>
<td>999, 1000</td>
</tr>
<tr>
<td>Anoquah, a dry harbor</td>
<td>378</td>
</tr>
<tr>
<td>Anzote keys, Florida, the building of a light-house with 1st-order lens at, proposed</td>
<td>712</td>
</tr>
<tr>
<td>Appalacheiculoa, light-house at, needs repairs</td>
<td>243</td>
</tr>
<tr>
<td>Apparatus, Blunt's, to be examined</td>
<td>140</td>
</tr>
<tr>
<td>Apparatus, most improved, one or more sets to be imported</td>
<td>125</td>
</tr>
<tr>
<td>Apparatus to be kept in repair by the oil contractor</td>
<td>25</td>
</tr>
<tr>
<td>Appropriations in relation to light-houses, recommended</td>
<td>876</td>
</tr>
<tr>
<td>Appropriations for light-houses, 1846-51, list of</td>
<td>674</td>
</tr>
<tr>
<td>Aransas Pass, Texas, a light-house with 1st-order lens proposed for</td>
<td>712</td>
</tr>
<tr>
<td>Archives, books, &amp;c., to be turned over to Light-House Board, act in relation to</td>
<td>901</td>
</tr>
<tr>
<td>Ashtabula beacon, keeper's dwelling needed</td>
<td>159</td>
</tr>
<tr>
<td>Ashtabula, description of</td>
<td>83</td>
</tr>
<tr>
<td>Assateague light-house, 1st-order lens and elevation of tower suggested for.</td>
<td>615, 711</td>
</tr>
<tr>
<td>Assateague inlet, buoys at, in bad order</td>
<td>239</td>
</tr>
<tr>
<td>Astronomical observations for position of light-houses</td>
<td>387, 388</td>
</tr>
<tr>
<td>Atchafalaya bay, La., floating light to be built</td>
<td>533</td>
</tr>
<tr>
<td>Atchafalaya bay, La., light-vessel has been built</td>
<td>537</td>
</tr>
<tr>
<td>Attendance, inspection, and superintendence, system of</td>
<td>874</td>
</tr>
<tr>
<td>Attendance upon the lights, for information asked in relation to</td>
<td>759, 775</td>
</tr>
</tbody>
</table>

## B.

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babbage, C., lighting system, description of</td>
<td>714</td>
</tr>
<tr>
<td>Babbage's numerical system, report of J. H. Alexander on</td>
<td>906</td>
</tr>
<tr>
<td>Babbage's system for distinguishing light-houses, description of</td>
<td>795</td>
</tr>
<tr>
<td>Babbage's system for indicating tide and depth of water</td>
<td>727</td>
</tr>
<tr>
<td>Babbage's system used in connection with fog-signals</td>
<td>737</td>
</tr>
<tr>
<td>Bache, G. W., lieutenant United States Navy, report of</td>
<td>202</td>
</tr>
<tr>
<td>Bache, Prof. Alex. D., resolutions of the Light-House Board on the death of.</td>
<td>1026</td>
</tr>
</tbody>
</table>
INDEX.

Balances remaining in Treasury, 1857, table G, showing .......................................................... 1082
Barletta lighthouse, buoy upon, considered necessary ............................................................... 47
Barneget light, a dull light .............................................................................................................. 737
Barneget light, an indiffident one .................................................................................................... 754
Barneget light-house, New Jersey, requires higher elevation and 1st-order lens 615, 711
Barneget light, not of sufficient range ........................................................................................... 659
Barnstable and Wellfleet harbors, not much frequented .............................................................. 389
Barnstable light, description of ...................................................................................................... 184
Bardleur light-house, (France,) description of ............................................................................... 277
Bartlett's Reef light-ship, a Dabol's fog-horn suggested for .......................................................... 810
Bartlett's Reef light-ship, a larger boat recommended ................................................................. 292
Bartlett's Reef light-ship, appropriation for a fog-signal at .......................................................... 809
Bartlett's Reef light-ship, description of ......................................................................................... 213
Bartlett's Reef light-ship has been built ......................................................................................... 536
Basin bank, a light-house on the, recommended .......................................................................... 30
Bass harbor, buoys in, needed ........................................................................................................ 44
Bartlett's point, St. Lawrence river, erection of a light-house at, recommended 145, 167
Battery point, California, contract for a light-house at ................................................................. 867
Beacon and spindles in Maine, located for convenience of contractors ...................................... 592
Beacons, uniformity in painting, marking, &c, of .......................................................................... 591
Beachamp's point, Maine, a light-house at, to be built ............................................................... 538
Beavertail point, appropriation for a fog-signal at ....................................................................... 809
Beavertail light, characteristic should be changed ....................................................................... 196
Beavertail light-house, fog-hell at, removed .................................................................................. 204
Beavertail point, a spar buoy on, recommended ........................................................................ 138
Bergen point, New Jersey, a light-house on, has been built ........................................................ 539
Betoux, River aux, capable of being made a safe harbor .............................................................. 250
Big Beaver island, Lake Michigan, a light-house at, suggested ................................................... 253
Big island, Maumee bay, report against a beacon at ................................................................. 148
Big Sandy creek, N. Y., report against the erection of a light-house at ..................................... 386
Billingssgate Island shoal, a beacon needed at ............................................................................. 380
Billing's gate light, description of .................................................................................................. 155
Billingssgate light-house, more or less ruin, requires rebuilding ............................................... 358
Bird Island light, characteristic should be changed ...................................................................... 196
Bird Island light, description of, and report on ............................................................................ 196
Bird Key shoal, Florida, beacon on, suggested .............................................................................. 794
Black River beacon, report about .................................................................................................. 160
Black river, description of improvements at ............................................................................... 83
Blackstone's island, Potomac river, light-house at, to be built ................................................... 532
Blackstone's island, Potomac river, title not satisfactory ............................................................ 536
Block island, a light-house wanted on the south side of .............................................................. 377
Block island, description of ........................................................................................................... 207
Block island, list of ships stranded on ............................................................................................ 209
Block Island light, report on, description of ................................................................................ 208
Blue light, distance visible ............................................................................................................. 713
Board, Light-House. organization of a temporary ........................................................................ 463
Board of navy and engineer officers, organization of .................................................................. 551
Board of navy and engineer officers, to examine condition of Light-House Establishment .... 550
Board, the organization of a Light-House Board, recommended ................................................ 445
Bobs island, Port Royal Sound, a beacon at, suggested .............................................................. 70
Bodkin point, number of reflectors in comparison with other light-houses ................................ 882
Bodkin point or Seven-foot knoll, plans for a screw-pile light-house at .................................... 789
Bodkin shoal, appropriation for a light-house at .......................................................................... 779
Body's island, a light-house at, more desirable than at Peas island .......................................... 65, 66
Body's island, a light-house at, recommended ............................................................................. 28, 32
Body's island, a light-house with revolving light 60 feet high, at, recommended .................... 241
Body's Island light, suggestion for improving ................................................................................. 774
Bois Blanc island, Lake Michigan, under-washed and destroyed ............................................. 311
Bois Blanc island, selection of site for light-house buildings ...................................................... 245
Bois Blanc light-house, well situated ............................................................................................ 87
Bolivar point, Texas, site for a light-house at, purchased ............................................................. 540
Books and public documents for reference, list of ...................................................................... 1029
Boone Island light-house, Maine, requires higher elevation and 1st-order lens 711
Borden, Simeon, recommendation for I. W. F. Lewis ................................................................. 385
Boston harbor, description of ........................................................................................................ 378
Boston harbor, suggested improvements for ............................................................................... 379
Boston light, description of ........................................................................................................... 189
INDEX.

Boston light-house, the erection of a fog-bell at, suggested.................. 372
Boston light, report on........................................... 179
Brandon's Cove, off Hudson river, necessity of a light at, doubtful........ 237
Brandywine light-house, (Delaware bay,) caisson for foundation completed 255
Brandywine light-house, estimate for protection wall........................ 261
Brandywine Shoal light, (Delaware bay,) description of........................ 604
Brandywine Shoal light-house, erected 1828, soon after tumbled down........ 311
Brandywine Shoal light, in comparison with Cape May and Cape Henlopen light........ 606
Brazos river, Texas, a light-house with 1st-order lens needed at........... 711
Brazos St. Jago, Texas, a light-house with 1st-order lens needed at........ 712
Brilliance of catadioptric apparatus in comparison with others............... 506
Broad Cove rock, near Cape Elizabeth, buoy on, recommended................. 38, 43
Brunswick, Georgia, harbor, buoys required for............................... 68
Brunswick, Georgia, report against erection of a light-house at............ 67
Buck's harbor, Brooksville, a light-house to be built, entrance of........... 555
Bude light, could be introduced when gas is used................................ 512
Buffalo, description of.................................................................. 81
Buffalo, description of the harbor of........................................... 151
Buffalo, State of New York, old light-house site to be sold................... 141
Bulwark ledge, or Cod ledge, buoys on, suggested............................... 38, 39, 42
Bunker's ledge, outside of Bear island, a monument on, required............ 44
Buoyage, our system of, in need of better management.......................... 744
Buoy, black, with uneven numbers, to be passed in entering on port hand... 550
Buoy, red, with even numbers, to be passed in entering on starboard hand... 550
Buoys, a general system recommended............................................ 445
Buoys, all to be colored...................................................... 550
Buoys and beacons, badly painted................................................ 751
Buoys, beacons, number of, increased since 1852................................ 1020
Buoys, coloring and numbering, report on........................................ 871, 576
Buoys, defective in size, material, &c........................................... 459
Buoys, different colors for, recommended......................................... 533
Buoys in channel-ways, to be colored with alternate perpendicular stripes 550
Buoys, information about................................................................... 611
Buoys in lower bay of New York, in bad condition............................... 791
Buoys in Maine, New Hampshire, and Massachusetts, location of............. 374
Buoys in the waters of the United States, defective............................. 586
Buoys, laws in regard to coloring and numbering of............................. 760
Buoys, management of the, in England............................................. 482
Buoys, remarks about light on.................................................... 763
Buoys, replacing of.......................................................................... 489
Buoys, suggestion for improvement................................................... 762
Buoys, systematical arrangement in England of.................................... 458
Buoys, too small, and not properly painted........................................ 614
Buoys with red and black stripes, to be passed on either hand................. 550
Bush Key light-house, Tortugas, the height should be increased thirty feet 243

C.

Calumet river, a light-house at, to be built under Topographical Bureau........ 540
Calumet river, description of....................................................... 250
Campbell's island, Cape Fear river, light-beacon building at.................. 536
Campbell's island, Cape Fear river, light-house to be built.................... 533
Cape Ann, the rock off, should have a spindle.................................... 573
Cape Blanco, Pacific coast, a light-house proposed to be built, fitted with 1st-order lens...................................................... 712
Cape Canaveral light-house, Florida, a lens apparatus should be placed at.... 592
Cape Canaveral light-house, Florida, requires higher elevation and 1st-order lens...................................................... 710
Cape Canaveral light-house, Florida, higher elevation and 1st-order lens sug-gested for................................................................. 615
Capes, Florida, lights around......................................................... 740
Cape Canaveral light, Florida, if not improved, better dispensed with........ 743
Cape Canaveral, report in relation to re-establishing the light at............. 1029
Cape Charles, Va., light-house, requires higher elevation and 1st-order lens 711
Cape Cod light, description of and report on..................................... 186
Cape Disappointment light-house, Oregon, contract for......................... 867
Cape Elizabeth, description of...................................................... 372
Cape Fear light-house, higher elevation and 1st-order lens suggested for 615, 711
Cape Fear light, not of sufficient range 659
Cape Fear light, not visible at distance given 739
Cape Fear light, requires to be improved 762
Cape Fear, iron buoys for 556
Cape Flattery, Oregon, no sufficient appropriation 688
Cape Florida light, badly lighted and badly kept 741, 755
Cape Florida, commonly called Key Key 30
Cape Florida light-house, a lens apparatus should be placed at 592
Cape Florida, light-house at, ought to be built 241
Cape Florida light-house, explanation of Fifth Annual Report 305
Cape Florida light-house, requires higher elevation and 1st-order lens 615, 710
Cape Florida light-house, tower down or left as beacon 30
Cape Florida light, if not improved, better be dispensed with 743
Cape Florida light, most important on the coast 741
Cape Florida, not properly lighted 557
Cape Florida, report in relation to re-establishing the light at 1039
Cape Foulweather light-house, properly to be built, with 1st-order lens 712
Cape Greeenville, Pacific coast, light-house proposed to be built, fitted with 1st-order lens 712
Cape Hatteras, a light of greatest intensity needed at 738
Cape Hatteras, fog-bell needed at 738
Cape Hatteras light-house, N. C., a lens apparatus should be placed at 592
Cape Hatteras light-house, N. C., number of reflectors in comparison with other light-houses 882
Cape Hatteras light-house, N. C., requires higher elevation and 1st-order lens 615, 710
Cape Hatteras light-house, N. C., requires to be improved 752
Cape Hatteras light, if not improved, better be dispensed with 743
Cape Hatteras light, inferior by cause of unclear light 659
Cape Hatteras light, not of sufficient range 754
Cape Hatteras light, should be made first-class light 754
Cape Henlopen light-house, Del., a lens apparatus should be placed at 592
Cape Henlopen light-house, Del., requires higher elevation and 1st-order lens 615, 710
Cape Henlopen light-house, Del., requires to be improved 752
Cape Henry light-house, Va., a lens apparatus should be placed at 592
Cape Henry light-house, Va., 1st-order lens suggested for 615
Cape Henry light-house, Va., refitted with improved lantern 295
Cape Henry light-house, Va., requires higher elevation and 1st-order lens 711
Cape Henry light-house, Va., requires to be improved 752
Cape Henry light-house, Va., the first light-house built by United States Government 1791 292
Cape Lookout light-house, not kept in good order 738
Cape Lookout light-house, number of reflectors in comparison with other light-houses 882
Cape Lookout light-house, requires to be elevated and fitted with 1st-order lens 615, 711
Cape Lookout light, if not improved, better be dispensed with 743
Cape Lookout light, requires to be improved 752
Cape Lookout shoals, position and dangers of 738
Cape May light-house, 1st-order lens suggested for 615
Cape May light, not of sufficient range 659
Cape May light-house, requires higher elevation and 1st-order lens 711
Cape May light-house, revolving light suggested 752
Cape Mendocino, a light-house proposed to be built, fitted with 1st-order lens 712
Cape Poge light, description of and report on 196
Cape Poge light-house, requires rebuilding 358
Cape Romain light-house, S. C., a lens apparatus should be placed at 592
Cape Romain light-house, S. C., proposed to be built, fitted with 1st-order lens 712
Cape Romain light-house, S. C., requires higher elevation and 1st-order lens 615, 710
Cape Romain light, S. C., requires to be improved 752
Cape Romain light, S. C., towards morning, dim 739
Cape Sargo floating light, a danger to navigation 741
Cape San Blas, a light-house at, a useless expenditure 243
Cape San Blas light-house, Fla., requires higher elevation and 1st-order lens 711
Canaveral, Fla., a light-house at, recommended 241
Carysfort reef, and Key West, light recommended between 241
Carysfort reef, Fla., a revolving light suggested for 742
Carysfort reef, Fla., examination for foundation of a light-house at 20
Carysfort Reef light-vessel, explanation about 308
INDEX.

Cast-iron lighthouse, for situations out of reach of water ........................................ 651
Cast-iron lighthouse, gradually introduced ................................................................. 474
Catadioptric apparatus, note upon .................................................................................. 983
Cateoptric system, compared with the dioptric system, report in relation to ................. 890
Cattaragus creek, description of .................................................................................... 21
Cattaragus Lake Erie, description of ............................................................................. 155
Cedar Keys light-house, Fla., proposed to be built, fitted with 1st-order lens .......... 712
Cedar point, a lighthouse at, recommended ................................................................. 242
Cedar point, Sandusky bay, beacon-light at, to be erected ......................................... 160
Chambers' island, description of light-houses at, of great utility ................................. 86
Chairman of the Light-House Board, Capt. W. B. Shubrick, U. S. N., elected as ... 904
Chairman of the Light-House Board, act ordering the mode of electing the .............. 300
Chandaleur Island light-house, La., requires to be elevated and fitted with 1st-order lens ................................................. 711
Chandler, Senator, for detail of revenue officers as light-house inspectors ............. 892
Change of Light-House Establishment detrimental ..................................................... 1093
Channel rock, a buoy on, recommended ...................................................................... 185
Characteristics, distinctive, of light .............................................................................. 713
Characteristics, distinctive, of light, in England and France ....................................... 713
Characteristics, distinguishing, information in relation to ........................................... 756, 775
Characters, distinctive, of the lights of the United States ........................................... 629
Charges against management of Light-House Establishment, answered by .............. 116
Fifth Audit ............................................. .............................................................................
Chatham, East Inland, in Saginaw bay, a lighthouse suggested .................................. 246, 253
Charleston, beacons and buoys recommended for .................................................... 28, 32
Charleston harbor, fogs near, all the year round ......................................................... 739
Charleston light-house, requires higher elevation and 1st-order lens ....................... 615, 711
Charleston light-house, requires to be improved ......................................................... 762
Charleston light, revolving, should be a fixed light ..................................................... 882
Charleston light, steam wharf suggested .................................................................... 739
Charlotte harbor, Fla., a light-house proposed to be built, with 1st-order lens .......... 712
Charts of Liverpool harbor ........................................................................................... 485
Chatham light, description of and report on ................................................................. 188
Chatham light-houses, keeper's dwelling badly constructed ....................................... 358
Chatham, Mass., the two light-houses taken down and rebuilt .................................. 285
Chicago, description of ................................................................................................. 88
Chicago light-house, requires repairs ........................................................................... 345
Chicago, Lake Michigan, customs establishment suggested ....................................... 364
Chippewa river, description of, erection of a lighthouse recommended ................... 87
Circular to collectors of customs, &c., concerning I. W. P. Lewis, as inspector .......... 343
Circular to commanders of mail steamers, &c ............................................................ 735
City West, description of, erection of a lighthouse recommended ............................. 88
City West, Indiana, report against a light at ............................................................... 75
Clark's Point light, description of and report on .......................................................... 194
Classification, arrangement in reference to ................................................................. 712
Classification of lights, an assumed, in the United States .......................................... 620
Classification of lights in England and France ............................................................ 619
Classification of lights, information in relation to ....................................................... 756, 771
Classification of lights, no proper system of ............................................................... 575
Cleaning powder, not the right material ...................................................................... 874
Cleveland, Lake Erie, old light-house site to be sold ................................................. 141
Cleveland light-house ought to be discontinued, beacon all that is necessary .......... 83
Cleveland light-house, report about ............................................................................. 159
Cleveland, old light-house to be discontinued ............................................................ 141
Clinton river, Lake St. Clair, report against the erection of a lighthouse at .......... 249
Clock-work, lamps, &c., to be kept in repair by contractor ......................................... 22
Clopper's bar, Galveston bay, a light-house to be erected at .................................... 556
Coast of Florida, several new light-houses ................................................................. 28
Coast unreasonably lighted in different points ............................................................. 873, 875
Cockspur Knoll light-vessel, Savannah river, has been built .................................... 533
Colbeck's reef, (Minut ledge,) list of wrecks occurred in 1838, 1841 .......................... 347
Collectors of customs, circular to ................................................................................. 174
Collectors of customs, inspectors of lights, salary, &c ............................................... 763
Collectors of customs should not be inspectors of light-houses ................................. 461
Color, red, employed for distinction ........................................................................... 456
Colza oil, acid reaction by some ................................................................................... 937
Colza oil, loss of, in comparison with sperm oil ......................................................... 766
Colza oil, flame more brilliant than sperm flame ......................................................... 905
INDEX.

Colza oil, remarks about ................................................. 1021
Colza oil, the cultivation of the colza plant recommended......... 279
Communication from the Light-House Board, to the reply of Fifth Auditor ......................................................... 569
Comparison of annual cost of lights in United States, with foreign countries, erroneous ............................................. 880
Comparison of the systems of lighting in United States, France, and England ............................................................. 648
Compensation, communication about, navy and army officers .... 905
Condition, general, of the United States Light-House Establishment .... 542
Condition, general, of the United States light-houses, report on the ................................................................. 597
Condition of the Light-House Establishment, disordered, &c. .... 341
Condition of towers and other buildings ................................ 63
Commencement, description of and improvements at ................. 23
Commencement, description of and improvements at ................. 23
Commencement, description of and improvements at ................. 23
Commanemnt River beacon, Lake Erie, light-house dwelling, necessary ................................................................. 158
Construction, detailed programme to improve the present mode of ................................................................. 687
Construction, for information in relation to ................................... 760
Construction, light-house, involves professional knowledge ......... 874, 875
Construction, no systematic economical plan of, has been employed ... 873
Construction of light-houses, information in relation to ............. 775
Construction of light-houses in Maine, description of ............... 355
Construction of the light-houses not creditable to the reputation of contractor ............................................................. 695
Construction of light-houses, to be approved by Light-House Board .... 716
Construction of light-houses, to be intrusted only to an officer of engineers ............................................................. 1069
Construction of light-houses uniform, no consideration given to present location ................................................................. 353
Construction, plans and drawings for information in relation to .......... 757
Consumption of oil in French lenses, one-quarter of that in our Argand lamps .......................................................... 870
Contracting for building, apparatus and oil, mode of ................... 336
Contractor for oil, to report conduct of keeper and condition of building ............................................................. 21
Contractors, not held under rigid superintendence ...................... 873
Contracts, securing the faithful observance of ............................ 631
Contract system in the Light-House Establishment, a failure, proof of ................................................................. 230
Contract system, the arrangement of, suggested .......................... 338
Corner Stake, the erection of a beacon-light recommended .......... 138
Cost, annual, per lamp, for 1846, 1851, in the United States ........ 676
Cost, annual, per lamp, in England ........................................ 677
Cost, annual, per each light-house and beacon, average .............. 988
Cost, average, of a light-house, in comparison with England and France ............................................................. 318
Cost, average, of maintaining a light, in comparison with England and France ............................................................. 319
Coste, N. L., ordered to make observations and inquiries concerning light-houses on coast between Tampa bay and Cape Henry .......... 28
Cost of construction of light-houses, light-ships, &c., per year, since 1791 ................................................................. 316
Cost of Light-House Establishment, erroneous, given by Fifth Auditor ................................................................. 879
Cost of Light-House Establishment, 1847, 1852, table A, showing the ................................................................. 997
Cost of Light-House Establishment, 1853, 1857, table B, showing the ................................................................. 998
Cost of Light-House Establishment under Light-House Board, in comparison with former years ........................................... 990
Cost of our light-vessels erroneously stated ........................... 881
Cost of the gradual introduction of the French system ................. 669
Cost, per lamp, in the Colonical lights of Great Britain, less than in England and the United States ........................................ 684
Cosxaseeck light, Hudson river, description of, report on ........... 282
Crabtree's point, ledge off, a spar buoy on, found necessary ........ 49
Cranly island, light at, defective ........................................... 881
Cross-over island, (St. Lawrence river,) erection of a beacon-light recommended ......................................................... 167
Cross Rip light-vessel, report on ............................................. 191
Crown point, (Lake Champlain,) erection of a light-house at, recommended ............................................................. 169
Cuckold rock, between Segrin and Townsend harbor, monument on, suggested ......................................................... 47
Cumberland Head light-house, Lake Champlain, report about ......... 163
Cumberland island, explanation about the removal of, reply of Fifth Auditor ............................................................. 314
Cunningham Creek beacon, report about .................................... 159
Cunningham island, report against the erection of a light-house at .... 75, 83
Currituck, N. C., sea-coast light proposed to be built, fitted with 1st-order lens ............................................................. 711
Cutterhunk light-vessel, a cause of shipwrecks .......................... 744
Cutterhunk light-vessel, description of and report on ................... 194
Cutter Rain light-house and buoy tender, explanation about .......... 307
Cuttyhunk light-house, defective, requires rebuilding .................. 368
Cylinders, hollow, used for foundations in sandy soil ................... 755
INDEX.

D.
Daboll's air fog-whistle, report in relation to .................................................. 813, 814
Daboll's fog-signal, petition for the adoption of ................................................. 812
Darracott, George, recommendation for I. W. P. Lewis ....................................... 386
Dauphin island, a light-house at, useless ............................................................ 242
Davenport, H. K., captain, letter about light-house matters .............................. 753
Day point, Va., a light- vessel on the spit off, preferable ................................... 63
Day point, Va., report against a light-house at ................................................... 62, 63
Dead Man's point, Fla., light-house proposed to be built and fitted with 1st-order lens ................................................................. 712
Delano, J. C., letter from Captain ............................................................................ 743
Delaware breakwater, a light-house on, has been built ......................................... 539
Delaware breakwater, eastern extremity, beacon-light recommended ................. 239
Delaware breakwater, fog-hunt at, recommended .................................................. 239
Delaware flats, in Maumee bay, Ohio, beacon necessary ....................................... 148
Depot keepers, duties to be performed by .............................................................. 462
Dioptric apparatus, proposed to be introduced by Committee of Commerce .... 135
Dioptric apparatus to be imported ........................................................................... 140
Dioptric (Fresnel) light at Isle of May, superior to reflecting light ..................... 887
Dioptric light, in comparison with catoptric light .................................................. 668
Dioptric light of Inchkeith, report of the engineer to Scottish Light-House ... 886
Comission ................................................................................................................... 886
Discontinuance of unnecessary lights ...................................................................... 717
Disk buoys for Nantucket shoals, suggested ......................................................... 852
Distances and bearings of the light between Buffalo and Gibraltar ..................... 149
Distances of visibility of light-houses given by Lewis, wrong .............................. 117
Distinction, defective arrangement of our lights in regard to ............................... 495
Distinctive characteristics, combination of light possessing .................................. 503
District, first, extension of ....................................................................................... 143
Districts, Atlantic coast and lakes to be divided in ............................................. 140
Districts, light-house, act creating the .................................................................... 901
Districts, light-house, extension of ......................................................................... 170
Districts, light-house, not exceeding twelve in number ....................................... 559
Districts, the lakes divided into two ........................................................................ 143
Dog Fish ledge, a buoy on, recommended .............................................................. 262
Dog island, the site for the light-house on, a good one ......................................... 243
Drummer's ledge, to place a buoy on, recommended ............................................ 43
Drummond's light, experiments made on ................................................................ 452
Drummond light, not introduced in France ............................................................ 512
Drunker's ledge, near Mark island, buoy on, recommended ................................. 39
Drum point, mouth of Patuxent river, beacon-light recommended ..................... 239
Dry bank, Fla., a light-house proposed to be built, with 1st-order lens ............... 711
Dry Tortugas, Fla., a lens apparatus should be placed at ..................................... 592
Dry Tortugas light-house, Fla., requires higher elevation and 1st-order lens ...... 615, 710
Dues, collecting in England upon all vessels for light-house purposes ............... 449
Dues, no charge upon shipping in France for light-house purposes ...................... 498
Dumpling Rock light, description of and report on ............................................... 194
Dunkirk, description of ............................................................................................ 82
Dunkirk harbor, description of ................................................................................. 156
Dunkirk, old light-house to be discontinued ............................................................ 141
Dutch Island light, description of and report on .................................................... 295
Dwelling-houses for keepers, size of ......................................................................... 20

E.
Eagle harbor, Lake Superior, a light-house at, to be built .................................. 539
East Key, (Tortugas,) no advantage to be derived by placing a light-house at ... 243
East Thomaston, a breakwater at, much needed ................................................... 377
Eaton's Neck light, description of and report on .................................................... 218
Eaton's neck, number of reflectors in comparison with other light-houses ........ 882
Economy (relative) of reflector and lens systems .................................................. 660
Economy (relative) of United States and foreign lights ....................................... 661
Edgartown harbor, a breakwater required ............................................................... 390
Edgartown Harbor light, description of and report on ......................................... 180
Edgartown harbor, three buoys and one spindle in ............................................. 190
Eel Grass Shoal, the light- vessel formerly at Bartlett's reef removed to .......... 536
Egg Harbor light, a decoy to draw vessels into difficulty ........................................ 754
Egmont key, Tampa bay, Fla., a light-house at, required ........................................ 243
Egmont key, Tampa bay, light-house, requires higher elevation and a 1st-order lens ........................................ 711
Engineer, an, absolutely indispensable to Light-house Establishment ........................................ 450
Engineer officer, all constructions, repairs, &c., should be made under ........................................ 590
Engineer officers, to be detailed to construct and superintend light-houses ........................................ 550
Engineer of the Light-house Establishment, duties of, suggested ........................................ 460
Engineer secretary, act in relation to the duties of ........................................ 901
Engineer secretary of the Light-house Board, duties of the ........................................ 559
Engineers, competent, have not been employed to plan and superintend construction ........................................ 873
England, light-house system of, description of ........................................ 664
England, organization and management of the Light-house Establishment of ........................................ 466
England, Trinity Board, receiving their means from light duties levied upon shipping ........................................ 672
English Light-house Establishment, organization of ........................................ 269
Erie harbor, beacon required at ........................................ 82
Erie harbor, description of ........................................ 82
Esopus Meadows light-house, appropriation for, insufficient ........................................ 19
Estimates of expense for light-house service to be furnished by Light-house Board ........................................ 902
Estimates and plans for new light-houses to be made ........................................ 141
European light-house systems, direction for examining the ........................................ 446
European light-house systems, instructions for examining ........................................ 447
European light-house systems, report of Lieutenants T. A. Jenkins and R. Bache on ........................................ 449
Examination of the condition of Light-house Establishment, instruction for the ........................................ 341
Examination upon the condition of light-houses, beacons, &c., by I. W. P. Lewis ........................................ 337
Execution rock, a Daboll's fog-horn suggested for ........................................ 810
Execution rock, a light-vessel at, recommended ........................................ 55
Execution rock, a light-house on, recommended ........................................ 226
Execution rock, appropriation for a fog-signal at ........................................ 809
Execution rock, appropriation insufficient ........................................ 55
Execution rock, description of ........................................ 226
Execution rock, Long Island sound, a light at, necessary ........................................ 54
Execution rock, number of reflectors in comparison with other light-houses ........................................ 882
Expense, average annual, of light-houses, &c., 1847-1852, table H, showing ........................................ 1003
Expense, information in regard to the, of erecting light-houses, &c ........................................ 957
Expense of the English and American light, comparison of ........................................ 860
Expenses for oil in the light-houses in Scotland ........................................ 496
Expenses for surveys and plans for light-houses to be paid ........................................ 141
Expenses of the Light-house Establishment for 1841 ........................................ 287
Experiments with different light apparatus ........................................ 172
Explanation of Fifth Auditor, concerning light-houses, having fallen down ........................................ 311
Extent of the Light-house Establishment ........................................ 543

F.

Fairweather island, blown down and rebuilt ........................................ 314
Fairweather Island light, (Black Rock harbor,) description of and report on ........................................ 216
Fallen-down light-houses, number of ........................................ 881
False lights on our coast complained of ........................................ 746
Parallon, point E. 5 N. of, light-house proposed to be built with 1st-order lens ........................................ 712
Paralones light-house, Cal., contract for ........................................ 867
Pesquendo, Senator, for not changing light-house system ........................................ 892
Fifteen miles north of Indian River inlet, Fla., light-house proposed to be built ........................................ 711
Fire Island Inlet light-house, requires higher elevation and 1st-order lens ........................................ 615, 710
Fire Island Inlet light-house, New York, a lens apparatus should be placed at ........................................ 592
First-class light, not one on coast of the United States ........................................ 874
First district, report of inspector of ........................................ 177
First-order lens four times as economical as a 1st-order reflector light ........................................ 664
First-order lens light, equivalent to seventeen Argand burners, is erroneous ........................................ 877
First-order light, necessary on our coast ........................................ 658
Floating lights, English, description of ........................................ 276
INDEX.

Floating lights found in bad order ........................................... 613
Floating lights, information about ........................................... 767
Floating lights of the United States, useless .......................... 586
Florida Coast light inferior to Bahama Bank lights ............... 659
Florida coast, no confidence in our lights on the ..................... 746
Florida reefs, report of N. L. Coste about additional light-houses on. 30, 31
Flynn’s knoll, a bell buoy for, suggested ................................. 791
Flynn’s knoll, a light at, suggested ........................................ 795
Flynn’s knoll, bell beacon for ............................................... 593
Flynn’s knoll, bell buoy on, recommended ............................... 793
Flynn’s knoll, examination, description, location of ................. 797
Flynn’s knoll, for information asked in relation to .................. 785
Flynn’s knoll, information in relation to ................................ 788
Flynn’s Knoll light-house, erection of .................................... 19
Flynn’s Knoll light-house, report about expenditure, present state of work, &c. 295
Flynn’s Knoll light-house to be changed to range beacons ........... 593
Flynn’s knoll, no necessity for a light-house at ....................... 782
Flynn’s knoll, no light at, needed .......................................... 790
Flynn’s knoll, objections to the erection of a light-house at ....... 784
Flynn’s knoll, range on Jersey and Staten Island preferable to a light-house at .................................................. 799
Flynn’s knoll, report in relation to a light-house at ................ 783
Flynn’s knoll, report of the destruction of the work for a light-house at .......................................................... 297
Flynn’s knoll, the work on the light-house at, partly destroyed by a gale ............................................................... 296
Fog-bell, Boston harbor, report in relation to ......................... 816
Fog-bells, Morse’s, testimonials showing their importance, &c .... 231
Fog-bell of Morse, jr., to be tried ........................................... 140
Fog-bells, on a plan arranged by A. Morse, description of ......... 279
Fog-signals, remarks about ................................................... 628
Fog-signals, whistles for, suggested ....................................... 807
Fog-whistle and horn, Duboll’s, at Beavertail, report on .......... 810
Fog-whistle, Duboll’s, at Beavertail, report on ......................... 808
Fog-whistle, steam, J. H. Alexander’s, report of experiments on . 973
Foreign light, superior to ours ............................................ 751
Fort Gratiot, (Lake Huron,) in good condition ......................... 244
Fort Mifflin Pier light-house, has been built ......................... 536
Fort Warren, Boston harbor, small beacon-light required ........ 376
Foundations of the light-houses and keepers’ dwellings in Massachusetts badly constructed .............................................. 358
Four-mile Point light, (Hudson river,) description of and report on ................................................................. 292
Fox river, green bay, large spar buoys should be placed at ........ 827
Fox river, head of green bay, channel over the flats near, should be buoyed out ...................................................... 293
France, light-house service of, extract from Parliamentary report . 817
France, light-house system of, description of .......................... 649
France, list of light-house commission of ................................. 818
France, management of buoys in ............................................ 512
France, management of the light-house establishment in .......... 499
France, organization of the light-house establishment of .......... 497
France, present organization of light-house service ................. 509
France, superintendence of light-houses confined to engineers .. 500
Frank’s Island light-house, erected 1826, rebuilt 1822 .......... 311
Frauds in the construction of light-houses common and allowed to pass ............................................................... 353
French light-house establishment, organization of .................. 277
French light-house system, organization of the ....................... 450
French lenses, list of our light-houses fitted with ................. 765
Fresnel apparatus superior to all other ................................ 463
Fresnel apparatus superior to the English and our lights .......... 822
Fresnel dioptric apparatus, report of Profs. Pierce and Lovering on . 823
Fresnel lens superior to any other mode of light-house illumination .............................................................. 874
Fresnel or lens system, adoption of, recommended .................. 590
Frying-pan shoal, Cape Fear, a 3500 light-veelosh should be placed at ................................................................. 592
Frying-pan shoal, Cape Fear, buoyage of ................................ 751
Frying-pan shoal, Cape Fear, fog-bell needed at ..................... 739
Frying-pan shoal, light-veelosh on, suggested ......................... 754
<table>
<thead>
<tr>
<th>G.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galaxi, ship, was lost in consequence of not knowing that Barnegat light was in existence.</td>
<td>99</td>
</tr>
<tr>
<td>Galloo Island light-house, Lake Ontario, report about.</td>
<td>166</td>
</tr>
<tr>
<td>Galloo Island light-house, Lake Ontario, number of reflectors in comparison with other light-houses.</td>
<td>882</td>
</tr>
<tr>
<td>Galvanic action upon the iron cable at Barnegat's Reef light-vessel.</td>
<td>223</td>
</tr>
<tr>
<td>Galveston bar, a light-boat on, has been built.</td>
<td>539</td>
</tr>
<tr>
<td>Galveston bar, Texas, a light-house with 1st-order lens proposed for.</td>
<td>711</td>
</tr>
<tr>
<td>Gardiner's island, Long Island, the erection of a light-house recommended.</td>
<td>225</td>
</tr>
<tr>
<td>Gas, Al. Stevenson against its use in sea-coast light.</td>
<td>452</td>
</tr>
<tr>
<td>Gas apparatus, cost of erecting a</td>
<td>438</td>
</tr>
<tr>
<td>Gas, correspondence about.</td>
<td>439</td>
</tr>
<tr>
<td>Gas, extract from the report on.</td>
<td>440</td>
</tr>
<tr>
<td>Gas for light-houses, its advantages and disadvantages.</td>
<td>427</td>
</tr>
<tr>
<td>Gas for light-houses, the economy of, as compared with other kinds of lights.</td>
<td>438</td>
</tr>
<tr>
<td>Gas for light-houses, the fitness of.</td>
<td>427</td>
</tr>
<tr>
<td>Gas, information about, cost of, inquired for.</td>
<td>436</td>
</tr>
<tr>
<td>Gas, instead of oil, communication about using, in light-houses.</td>
<td>398</td>
</tr>
<tr>
<td>Gas, instead of oil, report about the use in light-houses.</td>
<td>419</td>
</tr>
<tr>
<td>Gas, manufacture of, description of.</td>
<td>420</td>
</tr>
<tr>
<td>Gas, natural, used for a light-house, information about.</td>
<td>769</td>
</tr>
<tr>
<td>Gas, reasons against the use of, in light-houses.</td>
<td>522</td>
</tr>
<tr>
<td>Gas, used for light-houses, information about.</td>
<td>768</td>
</tr>
<tr>
<td>Gay Head light-house, Mass., a lens apparatus suggested for.</td>
<td>592</td>
</tr>
<tr>
<td>Gay Head light-house, Mass., 1st-order lens suggested for.</td>
<td>615</td>
</tr>
<tr>
<td>Gay Head light-house, Mass., more or less ruins, requires rebuilding.</td>
<td>358</td>
</tr>
<tr>
<td>Gay Head light-house, Mass., requires higher elevation and 1st-order lens.</td>
<td>471</td>
</tr>
<tr>
<td>Gay Head light-house, description of and report on.</td>
<td>394</td>
</tr>
<tr>
<td>Gedney's channel, New York harbor, better buoys suggested.</td>
<td>791</td>
</tr>
<tr>
<td>Gedney's channel, New York harbor, buoyed out.</td>
<td>19</td>
</tr>
<tr>
<td>Gedney's channel, New York harbor, range beacons for, recommended.</td>
<td>785</td>
</tr>
<tr>
<td>Gedney's channel, New York harbor, requires better buoying.</td>
<td>783</td>
</tr>
<tr>
<td>Geneseer river, N.Y., description of the proposed light-house at.</td>
<td>146</td>
</tr>
<tr>
<td>Geneseer river, N.Y., erection of a light-house on the pier at the mouth of.</td>
<td>146</td>
</tr>
<tr>
<td>Geneseer light-house, report about.</td>
<td>164</td>
</tr>
<tr>
<td>Gibraltar light-house, mouth of Detroit river, report about.</td>
<td>163</td>
</tr>
<tr>
<td>Gilbert's bar, near Jupiter inlet, Fla., a light-house with 1st-order lens proposed for.</td>
<td>711</td>
</tr>
<tr>
<td>Gilkey's harbor, Maine, a light-house at, to be built.</td>
<td>538</td>
</tr>
<tr>
<td>Glass, French plate, the use of, in lanterns.</td>
<td>765</td>
</tr>
<tr>
<td>Gloucester harbor, description of.</td>
<td>378</td>
</tr>
<tr>
<td>Goat Island light, description of and report on.</td>
<td>197</td>
</tr>
<tr>
<td>Goldsborough, buoys to be placed at.</td>
<td>555</td>
</tr>
<tr>
<td>Goldsborough, a light at the entrance of.</td>
<td>364</td>
</tr>
<tr>
<td>Grand river, description of, the erection of a light-house at, recommended.</td>
<td>91</td>
</tr>
<tr>
<td>Grand River light-house, report about.</td>
<td>150</td>
</tr>
<tr>
<td>Grand river, on east side of Lake Michigan.</td>
<td>251</td>
</tr>
<tr>
<td>Grand river, the light-house at, may be dispensed with, the beacon is all that is required.</td>
<td>83</td>
</tr>
<tr>
<td>Grass island, Detroit river, a beacon has been built.</td>
<td>538</td>
</tr>
<tr>
<td>Grass island, Detroit river.</td>
<td>533</td>
</tr>
<tr>
<td>Grassy island, near head of Green bay, unsuitable for the construction of buildings on it.</td>
<td>248</td>
</tr>
<tr>
<td>Grassy island, on head of Green bay, the erection of a light-house at, recommended.</td>
<td>80</td>
</tr>
<tr>
<td>Great Captain's Island light, description of and report on.</td>
<td>219</td>
</tr>
<tr>
<td>Great Duck island, a coast light required at.</td>
<td>376</td>
</tr>
<tr>
<td>Great Egg harbor, a buoy for.</td>
<td>556</td>
</tr>
<tr>
<td>Great point, Nantucket, by extending a breakwater, to be made a useful harbor.</td>
<td>390</td>
</tr>
<tr>
<td>Great West bay, Long Island, a light-house with 1st-order lens proposed for.</td>
<td>711</td>
</tr>
<tr>
<td>Green light, distance visible.</td>
<td>713</td>
</tr>
<tr>
<td>Gulf of the, the current at.</td>
<td>742</td>
</tr>
<tr>
<td>Gulf island, appropriation for fog-signal at.</td>
<td>809</td>
</tr>
<tr>
<td>Gulf island, a second light recommended during flood tide.</td>
<td>294</td>
</tr>
<tr>
<td>Gunkey, English light on, the best light.</td>
<td>741</td>
</tr>
<tr>
<td>Gunkey light, English, much superior to any on our coast.</td>
<td>755</td>
</tr>
</tbody>
</table>
INDEX.

II.

Half-moon shoal, Galveston bay, a light-house to be erected ........................................ 556
Half-tide ledge, a buoy on, suggested .......................................................... 49
Half-tide ledge, expendatures on, suspended ................................................. 49
Half-tide ledge, location and description of .................................................. 49
Half-way rock, erection of stone monument recommended .................................... 42
Half-way rock, suggestion to erect a light on .................................................. 39
Harbor light, the erection of, in France ......................................................... 517
Hartford, buoys for .............................................................................. 556
Hatch ledge, description of ............................................................................ 49
Health Commissioners of the State of New York, recommendations for I. W. P. Lewis ................................................................. 385
Height of a light, limited on a coast, where fogs prevail ....................................... 600
Height of light-house towers, classified in four classes ........................................ 764
Height of the sea-coast light should be 150 feet ................................................... 632
Hillsborough inlet, Fla., a light-house with 1st-order lens proposed to be built ........ 615, 711
Historical notes on Light-house Establishment in the United States ....................... 228
History of French light-house system, adoption of the lenticular system ..................... 13
History of United States light-house system, by Fifth Auditor ............................... 133, 136
Hog island, Narragansett bay, a light-house could be erected on .......................... 53
Hog island, report against the erection of a light-house on ...................................... 60
Holmes’s Hole light, description of and report on ............................................... 192
Horse Island light-house, report about ................................................................... 166
Horseshoe, Cape Fear river, light- vessel to be built .............................................. 533
Horseshoe, Cape Fear river, suggested to remove the Brandywine Shoal light- vessel to .......................................................... 537
Horseshoe reef, Niagara river, appropriation for a light-house at ............................ 779
Horseshoe reef, Niagara river, under jurisdiction of Canada .................................. 538
Horseshoe reef, report on I. Smith’s plan for a light-house at ............................... 801
Hudson river, the small lamps at ........................................................................ 536
Humboldt harbor, Cal., contract for a light-house at ............................................ 867
Hunting island, South Carolina ............................................................................... 711
Huntington bay, a place of general resort in heavy weather .................................... 231
Huron beacon, report about .............................................................................. 160
Huron, description of improvements at .................................................................. 83
Hyannis harbor, requires a breakwater ................................................................... 380
Hyannis light-house, has been built ....................................................................... 535

I.

Identification of a light-house by Babbage system ................................................ 731
Illuminating apparatus, description and comparison of different ................................ 365
Illuminating apparatus is inferior .......................................................................... 573
Illumination, apparatus, report about the perfection of our .................................... 635
Illumination, service of the light-houses in France ................................................ 517
Illumination, information in relation to, asked ....................................................... 767
Illumination, improvement in the materials for ..................................................... 718
Illumination, mode of, in Scottish light-houses ....................................................... 493
Illumination of light-houses, information in relation to ........................................... 772
Illumination of the light-houses of Maine, New Hampshire, and Massachusetts, correspondence about .......................................................... 363
Illumination, suggestion for .................................................................................... 702
Improvement in American light, progress of ......................................................... 392
Improvement in light-house system, report of the Secretary of the Treasury ......... 441
Improvement of Light-house Establishment, suggestions for ......................... 338, 748
Improvement, report of Fifth Auditor to the Secretary of the Treasury con- cerning ........................................................................................................ 19
Indian key, Fla., a light-house at, recommended .................................................... 30
Inferiority of our light proved by E. and G. W. Blunt .............................................. 119
Information collected by Light-house Board ......................................................... 876
Information in relation to Light-house Establishment ............................................ 763
Information on light-house matters, correspondence about .................................. 769
Information upon the subject of executing the law for building light-houses ............ 18
Isleof Keith light-house, (Scotland,) description of ............................................... 274
Inspection, frequent and rigid, necessary ............................................................. 875
Inspection, manner and frequency of, report on ................................................... 644
Inspection of light-houses, done by collectors, badly executed ......................... 98
Inspection of light-houses, a more efficient plan for ............................................. 332
INDEX.

Inspection of the Light-house Establishment, mode of .............................................. 542
Inspection of light-houses, suggestions for an improved mode of .................................... 797
Inspection of light-houses, expenses of, incurred in a year by oil contractor ........................ 24, 36
Inspector and superintendent of districts, duties of ....................................................... 461
Inspectors of light-house districts, debate in United States Senate about detailing revenue officers as ................................................................. 889, 900
Inspectors of light-house districts, navy officers as ....................................................... 140
Inspectors of light-houses, officers of the navy suggested for ........................................ 749
Inspectors of lights, information asked in relation to ..................................................... 762
Inspectors under the authority of the Light-house Board have to report to the secretary ................................................................. 904
Instructions, best mode of securing attention to ............................................................ 717
Instructions of light-house keepers, about ................................................................. 875
Instruction to employés, subjects of ............................................................................. 417
Instruction to light-house district inspectors ................................................................. 144
Ireland, Light-house Board of, deriving their means from light dues ............................. 672
Iron-pile light-houses, first employed in England ........................................................... 691
Iron-pile light-houses, objections against ...................................................................... 692
Iron, situations most favorable for employment of .......................................................... 690

J.

Jekyll island, a light-house off the north of, of no service ........................................... 31
Jekyll island, Ga., report on the building of a light-house at ........................................... 66, 67
Jenkins, Commander Thornton A., acknowledgment of letter received by ......................... 1004
Jenkins, Commander Thornton A., complimentary resolution of Light-house Board to ................................................................. 1004
Jenkins, Lieutenant Thornton A., letter about condition of light-houses by ......................... 751
Juniper Island light-house, Vt., report about ................................................................. 169
Jupiter inlet, Fla., a light-house with 1st-order lens near, suggested ................................. 615
Jupiter inlet, report in relation to re-establishing light at .............................................. 1029

K.

Kalamazoo river, description of light-house at, recommended ........................................ 89
Kalamazoo river, on east side of Lake Michigan, building of a light-house not yet commenced ................................................................. 351
Keeper, one, not sufficient for a sea-coast light ................................................................ 574
Keepers' dwellings in Maine inconvenient, some without drinking water ......................... 351
Keepers, each sea-coast light should have two .................................................................. 454
Keepers, information in relation to .............................................................................. 775
Keepers, mode of procuring the service of proper ................................................................ 644
Keepers, new, in Scotland instructed for three months ..................................................... 492
Keepers not allowed to be absent from the light ............................................................. 592
Keepers, number of, allowed in France to different orders ............................................. 505
Keepers of each light-house allowed 20 gallons oil for household use ............................... 24, 36
Keepers on isolated light-houses to be supplied with rations .......................................... 591
Keepers, rations for English light-ship ............................................................................ 481
Keepers require to devote their entire time to their duties.............................................. 591
Keepers, salaries and management of the English light-house ........................................ 478
Keepers' salaries, law about ......................................................................................... 764
Keepers, suggestions about number, duties, and appointment of ..................................... 691
Keepers, suggestions for improving the condition and ability of .................................... 370
Keepers to undergo examination and instruction ........................................................... 591
Keepers, two, necessary for a 2d-order lens light ............................................................ 877
Kewanee river, has but little water, at present no light-house necessary ......................... 351
Kewanee river, description of ....................................................................................... 87
Key Biscayne, Fla., description of .................................................................................. 31
Key West, a light-boat in the Northwest passage recommended ........................................ 28, 30
Key West, Northwest bar, suggested to remove light- vessel of Triangle shoal to .......... 30
Key West, the light-boat at the bar of Northwest channel ............................................. 243
Kilogrammes of oil converted into gallons by an erroneous rule ..................................... 877

L.

Lake Boundary, northern, west of Detroit, report of Lieutenant J. T. Homans .................. 244
Lake Erie, report of improvements on, of advantage to commerce and navigation .......... 81
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakes and northern rivers, lights on, not lighted during the year</td>
<td>578</td>
</tr>
<tr>
<td>Lamps and reflectors, accusation of bad condition of</td>
<td>96</td>
</tr>
<tr>
<td>Lamps, number of, in the light-houses</td>
<td>96</td>
</tr>
<tr>
<td>Lamps, reflectors, apparatus, &amp;c., to be kept in apparent by oil contractor</td>
<td>22</td>
</tr>
<tr>
<td>Lamps, remarks about different</td>
<td>476</td>
</tr>
<tr>
<td>Lamps to be lighted at sunset, extinguished at sunrise</td>
<td>25</td>
</tr>
<tr>
<td>Lantern and glazing, information in relation to</td>
<td>774</td>
</tr>
<tr>
<td>Lanterns, and other accessories, defective and without ventilation</td>
<td>872</td>
</tr>
<tr>
<td>Lanterns, glazing, &amp;c., information in relation to, asked</td>
<td>765</td>
</tr>
<tr>
<td>La Plaisance Bay light-house, suggested to be discontinued</td>
<td>84</td>
</tr>
<tr>
<td>Law forbidding any person connected with light-house service to have pecuniary interest</td>
<td>560</td>
</tr>
<tr>
<td>Legislation in relation to light-houses, without estimates, &amp;c.</td>
<td>882</td>
</tr>
<tr>
<td>Lens and reflector light, Sir David Brewster on the comparative merit of</td>
<td>713</td>
</tr>
<tr>
<td>Lens apparatus, advantages of</td>
<td>443</td>
</tr>
<tr>
<td>Lens apparatus, description of</td>
<td>443</td>
</tr>
<tr>
<td>Lenses, dioptic apparatus, report about contracting for two</td>
<td>175</td>
</tr>
<tr>
<td>Lenses, dioptic, correspondence about</td>
<td>177</td>
</tr>
<tr>
<td>Lenses now employed, for the imperfect lamps and lanterns</td>
<td>1020</td>
</tr>
<tr>
<td>Lens light, economy of a, in comparison with a reflector light</td>
<td>877</td>
</tr>
<tr>
<td>Lens light, estimates of cost, changing our lights to</td>
<td>765</td>
</tr>
<tr>
<td>Lens or Fresnel system, the best known</td>
<td>724</td>
</tr>
<tr>
<td>Lens system adopted in United States Light-house Establishment</td>
<td>550</td>
</tr>
<tr>
<td>Lenticular apparatus, description of the illumination of</td>
<td>503</td>
</tr>
<tr>
<td>Lenticular apparatus, list of lights in England, having the</td>
<td>475</td>
</tr>
<tr>
<td>Lenticular apparatus, superior to English parabolic reflector</td>
<td>270</td>
</tr>
<tr>
<td>Lenticular apparatus used in France</td>
<td>501</td>
</tr>
<tr>
<td>Lenticular light apparatus, constructed under H. Lepaute, report about the two received from Paris</td>
<td>263</td>
</tr>
<tr>
<td>Lenticular light apparatus, instruction for, by H. Lepaute</td>
<td>265</td>
</tr>
<tr>
<td>Lenticular system, in comparison with reflector apparatus</td>
<td>553</td>
</tr>
<tr>
<td>Lewis's patent, letter of Fifth Auditor about</td>
<td>236</td>
</tr>
<tr>
<td>Life-boats, appropriations for</td>
<td>556</td>
</tr>
<tr>
<td>Life-boats, management of the Liverpool</td>
<td>488</td>
</tr>
<tr>
<td>Life-boats and their accessories, condition of the</td>
<td>629</td>
</tr>
<tr>
<td>Life-boats, our, inferior to the British</td>
<td>870, 872</td>
</tr>
<tr>
<td>Life-boats, report about condition of</td>
<td>623</td>
</tr>
<tr>
<td>Light-house administration, French, 1834</td>
<td>13</td>
</tr>
<tr>
<td>Light-house Board, act creating the</td>
<td>558, 900</td>
</tr>
<tr>
<td>Light-house Board, act regulating meetings of the</td>
<td>901</td>
</tr>
<tr>
<td>Light-house Board, a, should be created</td>
<td>593</td>
</tr>
<tr>
<td>Light-house Board, debates in the United States Senate about</td>
<td>560, 578</td>
</tr>
<tr>
<td>Light-house Board, Light-house Establishment turned over to</td>
<td>559</td>
</tr>
<tr>
<td>Light-house Board, organization of</td>
<td>558, 903</td>
</tr>
<tr>
<td>Light-house Board, proceedings of the meeting of the</td>
<td>903</td>
</tr>
<tr>
<td>Light-house Board, temporary, conclusions arrived at by the</td>
<td>584</td>
</tr>
<tr>
<td>Light-house Board, temporary, organization of the</td>
<td>579</td>
</tr>
<tr>
<td>Light-house Board, temporary, report of the</td>
<td>582</td>
</tr>
<tr>
<td>Light-house Establishment, a thorough organization required</td>
<td>590</td>
</tr>
<tr>
<td>Light-house Establishment, Committee on Commerce, report on</td>
<td>315</td>
</tr>
<tr>
<td>Light-house Establishment, letter about, by Fifth Auditor</td>
<td>289</td>
</tr>
<tr>
<td>Light-house Establishment, management not efficient</td>
<td>584, 587</td>
</tr>
<tr>
<td>Light-house Establishment, notes about management of the</td>
<td>1010</td>
</tr>
<tr>
<td>Light-house Establishment, prior to 1852, in comparison with, subsequent to 1852</td>
<td>1011, 1017</td>
</tr>
<tr>
<td>Light-house Establishment promotes commerce, consequently belongs under Secretary of Treasury</td>
<td>1022</td>
</tr>
<tr>
<td>Light-house Establishment, reorganization of the, recommended</td>
<td>460</td>
</tr>
<tr>
<td>Light-house Establishment, suggestions for improvement of the</td>
<td>594</td>
</tr>
<tr>
<td>Light-houses south of Chesapeake bay, report in relation to</td>
<td>28</td>
</tr>
<tr>
<td>Light-house system, legislation in extending and improving our</td>
<td>706</td>
</tr>
<tr>
<td>Light-house plans, drawings, &amp;c., for construction and repair of, to be prepared by engineer secretary</td>
<td>901</td>
</tr>
<tr>
<td>Light-houses, since 1832, nearly doubled</td>
<td>1020</td>
</tr>
<tr>
<td>Lighting and extinguishing, regularity of</td>
<td>640</td>
</tr>
<tr>
<td>Lightning-rods on light-houses, report on the</td>
<td>806</td>
</tr>
<tr>
<td>Light keepers should not be allowed to be absent</td>
<td>199</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Lightning-rods, floors, &amp;c., in the light-houses, report about condition of</td>
<td>635</td>
</tr>
<tr>
<td>Lightning-rods, remarks about</td>
<td>471</td>
</tr>
<tr>
<td>Light, Drs. Pierce and Lovering's experiments on</td>
<td>825</td>
</tr>
<tr>
<td>Light, ready for inspection by a fixed hour</td>
<td>199</td>
</tr>
<tr>
<td>Light-ships, solid bottoms of, suggested</td>
<td>238</td>
</tr>
<tr>
<td>Light-ships, suggestions about the keepers on them, &amp;c.</td>
<td>240</td>
</tr>
<tr>
<td>Lights, list of, inspected by the temporary Light-house Board</td>
<td>610</td>
</tr>
<tr>
<td>Lights, our, greatly inferior to English and Spanish</td>
<td>745</td>
</tr>
<tr>
<td>Lights should be distinguished by color and revolving</td>
<td>755</td>
</tr>
<tr>
<td>Lights, the, of the United States not as effective as the interest of commerce demands</td>
<td>871</td>
</tr>
<tr>
<td>Light, the, on our coast not satisfactory</td>
<td>869, 871</td>
</tr>
<tr>
<td>Little Calumet river, description of</td>
<td>88</td>
</tr>
<tr>
<td>Little Egg Harbor light, insignificant, liable to misguide vessels</td>
<td>737</td>
</tr>
<tr>
<td>Little Gulf light, description of and report on</td>
<td>213</td>
</tr>
<tr>
<td>Little Gulf island, number of reflectors in comparison with other light-houses</td>
<td>882</td>
</tr>
<tr>
<td>Little River headland, a lighted beacon at, required</td>
<td>375</td>
</tr>
<tr>
<td>Life-boats, remarks about</td>
<td>629</td>
</tr>
<tr>
<td>Liverpool harbor, arrangement of the lighting system at</td>
<td>485</td>
</tr>
<tr>
<td>Liverpool, light-houses, beacons, and buoys in the harbor of</td>
<td>483</td>
</tr>
<tr>
<td>Locating of sea and lake-coast lights</td>
<td>709</td>
</tr>
<tr>
<td>Loggerhead key, (Tortugas,) no advantage to be derived by placing a light-house at</td>
<td>243</td>
</tr>
<tr>
<td>Long Island head, (Boston bay,) a lenticular apparatus suggested for</td>
<td>255</td>
</tr>
<tr>
<td>Long Island Head light, description of</td>
<td>182</td>
</tr>
<tr>
<td>Lookout light, not of sufficient range</td>
<td>659</td>
</tr>
<tr>
<td>Losses in consequence of war, contractor not liable for any</td>
<td>24, 27</td>
</tr>
<tr>
<td>Love key, Fla., a beacon needed</td>
<td>794</td>
</tr>
<tr>
<td>Love key, Fla., erection of a light-house at, recommended</td>
<td>30</td>
</tr>
<tr>
<td>Love point, report against the erection of a light-house at</td>
<td>59</td>
</tr>
<tr>
<td>Lower middle ground, West Quoddy bay, a buoy at, required</td>
<td>92</td>
</tr>
<tr>
<td>Lumber rock, Gooseberry neck, a buoy on, recommended</td>
<td>209</td>
</tr>
<tr>
<td>Lynde Point light, description of and report on</td>
<td>214</td>
</tr>
<tr>
<td>Lynde Point light, new tower to be erected and old tower taken down at</td>
<td>214</td>
</tr>
<tr>
<td>Lynde Point or Saybrook light, explanation about</td>
<td>306</td>
</tr>
</tbody>
</table>

**M.**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mackinac island, a beacon at, recommended</td>
<td>86</td>
</tr>
<tr>
<td>Mackinaw harbor, a beacon-light at, recommended</td>
<td>249</td>
</tr>
<tr>
<td>Mackinaw strait, light-ship at, driven from her moorings</td>
<td>246</td>
</tr>
<tr>
<td>Mackinaw strait, present ship unit, should have a new one</td>
<td>246</td>
</tr>
<tr>
<td>Madison dock, or Cunningham creek, light at, useless</td>
<td>83</td>
</tr>
<tr>
<td>Mahon's Ditch light-house, explanation about</td>
<td>313</td>
</tr>
<tr>
<td>Maine, general statement as to navigation and present condition of light-houses, &amp;c., 1842</td>
<td>343</td>
</tr>
<tr>
<td>Maine, the light-houses, buoys, &amp;c., on the coast of, are inferior and badly arranged</td>
<td>344</td>
</tr>
<tr>
<td>Mayo's Beach light, should be discontinued</td>
<td>155</td>
</tr>
<tr>
<td>Mayo's Beach light, Wellfleet, discontinuance recommended</td>
<td>392</td>
</tr>
<tr>
<td>Mamajuda island, Mich., a beacon-light to be built</td>
<td>533</td>
</tr>
<tr>
<td>Mamajuda island, Mich., a beacon at, has been built</td>
<td>538</td>
</tr>
<tr>
<td>Management, description of, in Light-house Establishment</td>
<td>616</td>
</tr>
<tr>
<td>Management, general, of light-house system, unfavorably reported by Chamber of Commerce</td>
<td>142</td>
</tr>
<tr>
<td>Management of light-house system, view to improve the</td>
<td>199</td>
</tr>
<tr>
<td>Management of United States light-houses inferior to other nations, by E. &amp; G. W. Blunt</td>
<td>94</td>
</tr>
</tbody>
</table>
INDEX.

Manhattan, Ohio, report against a beacon-light at or near .......................... 73
Manhattan, the town of, report in relation to improvement .......................... 84
Manistee river, can be made to be an excellent harbor .............................. 250
Manitou Island, Lake Superior, a light-house has been built at .................... 540
Manitowac river, the erection of a light-house at, suggested ......................... 87
Marble Head harbor, could be protected by breakwater ............................. 378
Marine Society at Boston, opinion about light-houses on eastern shore ............ 268
Mark Island ledge, buoys on, suggested .................................................. 38, 39, 43
Mark island, objections against a light-house on .................................... 39, 42
Mark island, suspension of expenditure at .............................................. 38
Martin's Industry, Georgia, description of .............................................. 69
Martin's Industry light-boat, perfectly useless ......................................... 740
Martin's Industry light-ship, badly placed and badly lighted ....................... 754
Martin's Industry, report against a light-vehicle at .................................. 69
Massachusetts, general statement as to navigation and present condition of light-houses, 1842 .......................................................... 346
Massachusetts, the bad arrangement of distinguishing light on the coast of ......... 350
Matagorda island, Texas, a light-house with 1st-order lens proposed .............. 711
Matagorda island, Texas, site of a light-house at, purchased ....................... 540
Material, cleaning, furnished to keepers unfit for use ............................. 612
Materials for construction and repair of light-houses to be procured by contract .......... 592
Matinicus Rock light-house, Maine, requires higher elevation and 1st-order lens .... 711
Matinicus Rock light-house, the rebuilding recommended .......................... 393
Mauwee bay, light-boat at Mackinaw strait suggested to be removed to .......... 73
Maurice river, New Jersey, a light-house on east side of, has been built .......... 539
Members of the Light-house Board, list of ............................................. 1027, 1029
Mermentua, La., a light-house with 1st-order lens proposed ....................... 712
Metaposet harbor, lights, buoys, &c., in the .......................................... 196
Michigan City light, in good condition ................................................... 245
Middle ground, buoy recommended in Westport harbor, on the edge of .......... 392
Middle Ground light-vehicle, of Middle Ground shoals ................................ 316
Middle ground, near York spit, a light-vehicle at the head of, suggested .......... 62, 243
Middle Sister island, (English,) the erection of a light on, suggested ............. 84
Mill rock, a spar buoy recommended ....................................................... 138
Milwaukee river, a light-house at, much wanted, also described of ................ 87
Milwaukee light-house to be removed to north point of Milwaukee bay .......... 556
Milwaukee, west side of Lake Michigan, objections against the site for a light-house .......................................................... 252
Milwaukee, west side of Lake Michigan, the erection of a light-house begun .... 251
Milwaukee, Wisconsin, a pier-light has been placed at ................................ 537
Minot's ledge, Cohasset rocks, a light-house on, more required than anywhere else .......................................................... 376
Minot's ledge, Cohasset rocks, list of wrecks, 1833-41 ................................ 347
Minot's ledge, description of ................................................................. 544
Minot's Ledge light-house, description of ................................................. 1005
Misrepresentation of Light-house Establishment by J. W. P. Lewis, letter by Fifth Auditor about ................................................................. 397
Mississippi and Sabine rivers, special examination of the coast between ........ 141
Mississippi Passes light-houses, 1st-order lens and higher elevation suggested for .......................................................... 615
Mobile light-house, characteristic changed without public notice ................. 100
Mobile Point light, explanation of Lewis concerning the characteristic of the light .......................................................... 16, 17
Mobile Point light, letter of Fifth Auditor to Lewis about characteristic of light at .......................................................... 16
Modern light-houses, our, inferior to older ones ...................................... 873
Monomoy light, description of and report on ............................................ 189
Monomoy light-house, more or less ruins, requires rebuilding ....................... 358
Montauk light, description of and report on ............................................. 269
Montauk Point light-house, 1st-order lens and higher elevation suggested for 615, 711
Montauk Point light-house, in construction .............................................. 95
Montauk point, New York, a lens apparatus should be placed at .................. 592
Monterey, Cal., contract for a light-house at ........................................... 867
Mooring of buoys in the United States very defective ............................... 647
Morgan's Point light, description of and report on .................................... 212
Moro light, (Havana,) the best light on this side of the Atlantic .................. 755
Moro light, kept in best order ................................................................. 741
Mortar made with fresh water and sand not so adhesive as when made with
salt water and sand. ............................................. 390
Mortar, may add ground and frost destroy its adhesive quality? .... 388
Mortar, the solidification of the, curious facts about. ................. 697
Mosquito Inlet light-house, coast of Florida, so badly built that it fell to the
ground ............................................................. 395
Mount Desert island, a light-house to be built on, not recommended .... 43
Mount of Tampa bay, erection of a light-house at ................... 29
Mouth of Detroit river, report in favor of revolving light at ......... 84
Mount Desert Rock light-house, Maine, requires higher elevation and 1st-order
lens .................................................................... 711
Muscle lodge, so dangerous to navigation, has no beacon ............. 345
Muscle Ridge channel, buoys and beacon to be erected in .......... 555
Muskegon river, Mich., a light-house at, to be built ................. 538
Muskegon river, on Lake Michigan, erection of a light-house at, suggested .. 249
Musquito bar, Fla., a light-house with 1st-order lens suggested at .... 711
Musquito bank, Fla., a light-house at, recommended ................. 30
Musquito bank, Fla., description of ................................ 31
Musquito Inlet light-house, destruction of .............................. 312

N.

Nantucket bar, four buoys and one buoy-boat on ...................... 191
Nantucket beacon, report on ...................................... 191
Nantucket great light, description of and report on .................. 191
Nantucket Harbor light, report on ................................... 191
Nantucket light, number of reflectors in comparison with other light-houses .. 882
Nantucket, Mass., south shoal off, a screw-pile light-house at ....... 539
Nantucket, New South shoal, description of ......................... 831, 836
Nantucket, New South shoal, estimate of cost to erect a light at .... 830
Nantucket, New South shoal, importance of .......................... 882
Nantucket, New South shoal, objections against the use of screw piles at . 838
Nantucket, New South shoal, plan for ................................ 844
Nantucket, New South shoal, plan of operations for the erection of a light-
house at .................................................................. 847
Nantucket shoals, extremely dangerous to navigation, and the erection of
screw-pile beacons on them suggested ............................... 349
Nantucket Shoal light, not of sufficient range ........................ 659
Nantucket shoals, the most dangerous portion of the coast, without a buoy .. 374
Nantucket South shoals, a 1st-class light-vessel should be placed at ... 592
Natchez light, explanation of the destruction of ....................... 311
Nanseet light, description of and report on ........................... 188
Naval officers recommended to make examination of light-house improvements. 142
Navesink Highlands light, report of the condition of ................. 598
Navesink light, consumption of oil at, not as reported ............... 877
Navesink light-houses fitted out with lenticular apparatus .......... 254
Navesink light, letter of Lieutenant Porter about condition of ....... 737
Navesink light, superior in brilliancy ................................... 751
Navesink light, the best light on our coast .............................. 754
Navy and army officers can best co-operate under neutral department ... 1092
Navy commissioners, instructed to report to the Treasury Department ... 18
Navy commissioners, instruction to ................................... 35
Navy commissioners, report of ...................................... 33, 34
Navy commissioners, report of the, in relation to examination of light-houses,
sites, &c .............................................................. 137
Navy commissioners, to cause examination of improvement for navigation, are
required ................................................................. 36
Nayat Point light, description of and report on ....................... 206
Newark bay, placing of four spar buoys in, recommended .......... 139
New Bedford harbor, beacon and buoys in ................................ 195
New Buffalo, description of, a light-house recommended at ....... 88
New Buffalo, Mich., a pier light at, has been built .................. 540
New Buffalo, at the mouth of Galier river, a light at, recommended .. 76
New Buffalo, site for a light-house selected .......................... 248
Newburyport, a barred harbor ........................................... 378
New Dungeness, Oregon, no sufficient appropriation ............... 898
New Haven light, description of and report on ....................... 215
New inlet, one buoy for ............................................. 556
<table>
<thead>
<tr>
<th>Index</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>New light, best mode of ascertaining the necessity for introducing</td>
<td>716</td>
</tr>
<tr>
<td>New light, best mode of supplying</td>
<td>716</td>
</tr>
<tr>
<td>New London light, description of and report on</td>
<td>213</td>
</tr>
<tr>
<td>New Matacumbe, a fixed light suggested</td>
<td>742</td>
</tr>
<tr>
<td>New Point Comfort, Chesapeake bay, number of reflectors in comparison with other light-houses</td>
<td>882</td>
</tr>
<tr>
<td>New Point Comfort, Chesapeake bay, refitted with improved lantern</td>
<td>285</td>
</tr>
<tr>
<td>Newport harbor, buoys in</td>
<td>197</td>
</tr>
<tr>
<td>Newport light, description of and report on</td>
<td>195, 197</td>
</tr>
<tr>
<td>New River inlet, a light-house with 1st-order lens proposed to be built</td>
<td>712</td>
</tr>
<tr>
<td>New South shoal, compared with Edystone, Bellrock, and Skerryvore</td>
<td>853</td>
</tr>
<tr>
<td>New York Bar channel, should be better marked by buoys</td>
<td>532</td>
</tr>
<tr>
<td>New York harbor, range light in, suggested</td>
<td>783</td>
</tr>
<tr>
<td>Niagara light-house, report about</td>
<td>164</td>
</tr>
<tr>
<td>Nobsque light, description of and report on</td>
<td>193</td>
</tr>
<tr>
<td>North Black river, Mich., no light-house at, needed</td>
<td>539</td>
</tr>
<tr>
<td>North Black river, outlet of river closed by sand</td>
<td>250</td>
</tr>
<tr>
<td>North Brother island, price asked for</td>
<td>533</td>
</tr>
<tr>
<td>North Brother, New York, light-house to be built at</td>
<td>532</td>
</tr>
<tr>
<td>Notice to mariners in regard to changes in lights, &amp;c., report on</td>
<td>647</td>
</tr>
<tr>
<td>Notice to mariners, no systematic mode of giving</td>
<td>576</td>
</tr>
<tr>
<td>Notice to mariners, suggestions for improvement in system of</td>
<td>648</td>
</tr>
<tr>
<td>Norwalk Island light, description of and report on</td>
<td>219</td>
</tr>
<tr>
<td>Number of lamps in existing light-houses</td>
<td>24</td>
</tr>
<tr>
<td>Number of light-houses and floating lights</td>
<td>20</td>
</tr>
<tr>
<td>Number of lenses in the world in 1851</td>
<td>673</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oak island, Cape Fear river, light-house to be built</td>
<td>533</td>
</tr>
<tr>
<td>Oak island, N. C., light-houses at, have been built</td>
<td>537</td>
</tr>
<tr>
<td>Oak Island range-lights, too close to each other</td>
<td>759</td>
</tr>
<tr>
<td>Oak Orchard, report about</td>
<td>164</td>
</tr>
<tr>
<td>Occulting light, of the mechanism necessary for</td>
<td>734</td>
</tr>
<tr>
<td>Ocracoke light-house, on Shell Castle island, explanation about</td>
<td>314</td>
</tr>
<tr>
<td>Off Vermilion bay, La., light-house requires higher elevation and 1st-order lens</td>
<td>711</td>
</tr>
<tr>
<td>Ogdensburg light-house, report about</td>
<td>168</td>
</tr>
<tr>
<td>Oil, according to Blunt's report, not inspected and in bad condition</td>
<td>98</td>
</tr>
<tr>
<td>Oil, agreement between Fifth Auditor and C. W. Morgan &amp; Co., concerning</td>
<td>25, 25</td>
</tr>
<tr>
<td>Oil, best strained spermaceti, for consumption, from April 1 to December 1</td>
<td>23</td>
</tr>
<tr>
<td>Oil, best winter pressed, from head matter, from December 1 to April 1</td>
<td>23</td>
</tr>
<tr>
<td>Oil, chemical constitution or internal properties of</td>
<td>937, 957, 971</td>
</tr>
<tr>
<td>Oil, chimneys, &amp;c., not properly tested</td>
<td>874</td>
</tr>
<tr>
<td>Oil, chromatic tests</td>
<td>939</td>
</tr>
<tr>
<td>Oil, color as characteristic of</td>
<td>921</td>
</tr>
<tr>
<td>Oil, colza, preferable to spermaceti</td>
<td>719</td>
</tr>
<tr>
<td>Oil, colza, remains limpid at lower temperature than sperm oil</td>
<td>883</td>
</tr>
<tr>
<td>Oil, colza, suggestions for introducing</td>
<td>793</td>
</tr>
<tr>
<td>Oil, colza, superior to sperm oil</td>
<td>451</td>
</tr>
<tr>
<td>Oil, consumption of</td>
<td>932</td>
</tr>
<tr>
<td>Oil, colza, used in France</td>
<td>621</td>
</tr>
<tr>
<td>Oil, consumption of by 1st-order lens</td>
<td>604</td>
</tr>
<tr>
<td>Oil consumed by 2d-order lens</td>
<td>964</td>
</tr>
<tr>
<td>Oil, consumption of, in combustion</td>
<td>967</td>
</tr>
<tr>
<td>Oil, contractor of, has to keep lamps, reflectors, &amp;c., in good repair</td>
<td>22</td>
</tr>
<tr>
<td>Oil, contractor to supply, tube-glasses, wicks, buffkins, &amp;c</td>
<td>23</td>
</tr>
<tr>
<td>Oil, cooling and solidification, as characteristic of</td>
<td>932</td>
</tr>
<tr>
<td>Oil, cooling and solidification of different kinds of</td>
<td>950</td>
</tr>
<tr>
<td>Oil, density as characteristic of</td>
<td>932</td>
</tr>
<tr>
<td>Oil, expansion, as characteristic of</td>
<td>932</td>
</tr>
<tr>
<td>Oil, experiment of combustion of</td>
<td>933</td>
</tr>
<tr>
<td>Oil, experiments of illuminating powers of</td>
<td>934</td>
</tr>
<tr>
<td>Oil, fluidity as characteristic of</td>
<td>999</td>
</tr>
<tr>
<td>Oil, for light-houses in France, contracted for, price regulated quarterly</td>
<td>500</td>
</tr>
<tr>
<td>Oil, homalism of</td>
<td>937</td>
</tr>
<tr>
<td>Oil, inspection of the, inadequate</td>
<td>870, 872</td>
</tr>
</tbody>
</table>
INDEX.

Oil, letter of J. H. Alexander about inspection of .................................................. 319
Oil, materials for lighting; information about procuring and distributing, &c. .......... 766
Oil, odor as characteristic of ...................................................................................... 921
Oil on hand at commencement, quantity and kind of, consumed, &c. ...................... 22
Oil, physical properties or external characters ......................................................... 921, 949
Oil, qualitative associations of .................................................................................... 937
Oil, quantitative composition of ................................................................................. 937
Oil, report about congealing of .................................................................................. 178
Oil, sperm, should remain limpid at 28° Fahrenheit ................................................. 882
Oil, congealing and solidification of different ........................................................... 967
Oils, density of different ............................................................................................ 949
Oils, economical values of different .......................................................................... 957
Oils, gas, &c., experiments on, information asked in relation to ................................ 762
Oils, J. H. Alexander's and Morfit's second report on ............................................. 945
Oils, J. H. Alexander's report on ................................................................................. 921
Oils, J. H. Alexander's third report on ...................................................................... 960
Oils, illuminating power of different ........................................................................ 965, 969
Oils, thermal tests ...................................................................................................... 941
Oil, to advertise in Boston for, for the year 1842 ...................................................... 226
Oil, twenty gallons, for household use, allowed to keeper, furnished by contractor .................................................................................................................. 26
Oil, where it should be stored ..................................................................................... 633
Oil, where kept in European light-houses ................................................................. 455
Oil, use of, in Scottish light-houses, reflecting in comparison with refracting ...... 889
Old Cock, Hen, and Chickens, a light on, much needed ......................................... 377
Old Cock Rock, near Gooseberry Neck, the erection of a light-house on, recom- 196
   mended ...
Old-field Point light, description of and report on ................................................... 218
Old Point Comfort light-house refitted with improved lantern ................................ 285
Opinion of Attorney General about power of Secretary of the Treasury in light- 382
   house matters ....
Opinion of Attorney General asked for, question to institute a survey of Light- 381
   house Establishment .............................................................
Opinion of the Comptroller about accounts of J. W. P. Lewis ................................ 383
Organization, defective, leads to waste in construction, &c. ..................................... 872
Organization of the Light-house Board, act in relation to ........................................ 900
Organization of the Light-house Board, October, 1852-1871 ............................... 1027
Organization of light-house department, suggestions for ........................................ 236
Organization of light-house department, views on improving the plan of ............. 254
Organization of the light-house service in France ................................................. 15, 514
Orton's Point, Cape Fear river, light-house at, building ......................................... 537
Orton's Point, Cape Fear river, light-house to be built ............................................ 533
Oswego, Lake Ontario, light-house, number of reflectors in comparison with 882
   other light-houses ..................................................................................................
Oswego light-house, report about .......................................................................... 165
Oswego, old light-house to be discontinued ............................................................ 141
Otter Creek Point light (at the foot of Lake St. Clair) needs repairs .................... 244
Otter Creek Point light-house, report about ............................................................ 161

P.

Pacific coast, cost of light-houses, table F ............................................................... 1001
Palmer's island, near New Bedford, light-house has been built ............................... 536
Palmer's island, New Bedford harbor, a small beacon-light recommended .......... 377
Papoosh Squaw point, report against the erection of a light on ......................... 53
Parabolic reflector, oil gives in a lenticular apparatus three times more light 128
   than with a ..............................................................
Passaic river, New Jersey, a light-house at mouth of ........................................... 539
Pass a l'Outre light-house, La., 1st-order lens and higher elevation required for ... 711
Pay, rate of, for each lamp lit annually ................................................................. 24, 236
Peach island, report against the erection of a light-house at ................................ 64
Pearl river, La., a light-house at, does not seem to be required ......................... 77
Penobscot bay, a light-house to be built at the entrance of .................................. 555
Pensacola light-house, Fla., a 1st-order lens and higher elevation required for 615, 711
Pensacola, present light-house to be removed to height between old Fort Bar- 242
   rances and the Oaks .................................
INDEX.

Pentwater river can be made to be an excellent harbor ........................................ 250
Pere Marquette river can be made to be an excellent harbor ................................ 250
Perry, Captain M. C., report in relation to the light-houses of England and France ... 268
Perry, Captain M. C., extract from notices of light-houses in United States .......... 747
Petit Menan light-house, Me., 1st-order lens and higher elevation required for .... 711
Pickens, Fort, Pensacola, a light-house to be placed on the west angle of .... 242
Pigeon River lake, east side of Lake Michigan, should be opened ....................... 250
Places for light-houses, mode of ascertaining .................................................. 627
Plans and drawings of light-houses not preserved .............................................. 775
Plans and specifications should be furnished by engineer officers ..................... 750
Plans for light-houses, light-vessels, &c ............................................................. 627
Plum island light-house, description of and report on ....................................... 213
Plum island light-house, more or less ruin, requires rebuilding ......................... 358
Plymouth harbor requires beacons ........................................................................ 390
Plymouth light-houses in decayed condition and now ones recommended ............. 288
Plymouth light-house, more or less ruin, requires rebuilding .............................. 358
Plymouth light on Gurnet point, description of and report on ............................. 153
Pneumatic piles, (Dr. Potts's,) objections against the use of ......................... 842
Point aux Barques, description of a light-house at, recommended ...................... 85
Point aux Barques, near entrance to Saginaw bay, site for a light-house .............. 247
Point Comfort, range beacons at, suggested ..................................................... 730
Point Concepcion, Cal., contract for ................................................................. 867
Point Esteroes, Pacific coast, a light-house with 1st-order lens proposed to be built .............................................. 712
Point Gammon light, description of and report on .............................................. 189
Point Gammon light-house, more or less ruin, requires rebuilding ...................... 358
Point Judith light, description of and report on ............................................... 203
Point Jupiter, a light-house at, needed .............................................................. 740
Point Jupiter, a light-house on, suggested ......................................................... 755
Point Jupiter shoals, discovery and location .................................................... 740
Point Lyanas light-house, description of ......................................................... 485
Point of Shoals, James river, a light-house at, recommended .............................. 63
Point Wangoshance, probable cost of a light-house at ....................................... 86
Pollock rip, off Chatham, Mass., a light-vessel has been built ....................... 539
Poolbeg light-house, Ireland, description of ..................................................... 275
Pool's island, Chesapeake bay, number of reflectors in comparison with other light-houses ................................................................. 882
Poplar Point light, description of and report on ................................................. 207
Port Clinton (Lake Erie, Ohio) light, discontinuance recommended ................. 399
Port Clinton light-house may be discontinued .................................................. 84, 160
Port du Mort, Wis., light-house has been built ................................................ 537
Port du Mort, Wis., light-house to be built ...................................................... 533
Porter, David D., lieutenant, United States Navy, letter from ......................... 737
Portland harbor, a breakwater, to protect against northeast storm, wanted .......... 377
Portland harbor, description of ........................................................................... 82
Portland light-house, Lake Erie, lighted by natural gas .................................... 157, 769
Port Sheldon, near entrance to Pigeon River lake, a very useful private light-house .................................................. 250
Portsmouth harbor, N. H., description of ............................................................ 378
Portsmouth Harbor light, number of reflectors in comparison with other light-houses ................................................................. 882
Port Washington light-house, Wis., has been finished ..................................... 537
Port Washington, Wis., light-house to be built .................................................. 533
Position of a light-vessel cannot be changed without authority of the Board ... 905
Positions of beacons, buoys, sea-marks, &c., determining, placing, and replacing them ........................................................................................................ 645
Positions of buoys, beacons, &c, means employed to ascertain proper information in relation to ................................................................. 761
Positions of light-houses, light-vessels, information in relation to, asked .......... 756
Pottawatomie Island light, not inspected on account of stormy weather ............. 244
Potts's plan of sinking iron tubes by atmospheric pressure, trials of ................. 474
President of the Light-house Board, Secretary of the Treasury to be .......... 900
Presque Isle harbor, a colored light at, recommended ....................................... 86
Presque Isle, on Lake Huron, site for a light-house selected ............................. 248
Presque Isle light-house, report about ............................................................... 157
Price's creek, Cape Fear river, light-house to be built .................................... 533
INDEX.

Price's creek, Cape Fear river, range-lights so close to each other. 762
Price's creek, on Cape Fear river, site for a light-house purchased at 537
Proctorville, L.t., bay light, appropriation insufficient. 139
Proceedings of the Light-house Board, extracts from the minutes of 904
Provincetown Harbor light, description of and report on. 155
Provincetown, one of the best harbors in the United States. 390
Put-in-Bay island, erection of a revolving light at, recommended 84

Q.

Quality of American light inferior to British light of the same class. 869, 871
Quotations contained in Fifth Auditor's reply incomplete, date omitted, &c. 880

R.

Race Point light, description of and report on. 186
Race Point, shipwrecks on. 225
Race Point, west end of Fisher's Island, the erection of a light-house recommended. 224
Race, the, Long Island sound, sailing directions for 224
Racine, on west side of Lake Michigan, the erection of a light-house at, begun. 251
Raccoon point, I.a., light-house proposed to be built with Ist-order lens. 711
Ram island, objections against erection of light-house at. 46
Ram island, suspension of expenditures for a light at. 45
Range of lenticular lights, remarks on. 529
Rebecca shoal, Fla., beacon on, suggested. 794
Rebuilt light-houses, number of. 881
Red bend, Fla., light-house proposed to be built with Ist-order lens. 712
Red Fish bar, Galveston bay, light-house to be erected at. 556
Red light, information in relation to producing. 771
Red light, objections to. 713
Reflector and lamps, cost of. 682
Reflector, form, finest polish and quality of the plate most essential. 683
Reflectors, four classes of. 764
Reflector light, comparison of. 867
Reflectors not made according to scientific principles. 873
Regulations and general police of the Light-house establishment exceedingly defective. 639
Regulations concerning land necessary for a site. 234
Regulations for contract to build light-houses and light-ships, pay of keepers, &c. 235
Rejoinder of E. and G. W. Blunt to the reply of Fifth Auditor. 116
Removal and placing of light-vessels, &c., without giving ample notice. 576
Renovating light, mode of. 716
Repairs and maintenance of light-house buildings in France. 517
Repairs, authorization to make needed, circular in relation to. 3
Repairs, direction and making annual, remarks about. 645
Repairs, the extensive result of non-employment of competent person to plan. 872
Reply of Fifth Auditor to the report of the Light-house Board. 865
Reply of Fifth Auditor to the report of Lieutenants T. A. Jenkins and R. Bache. 866
Reply of Fifth Auditor, errors in the. 877
Responsibility not proper on the part of agents connected with Light-house Establishment. 874
Report concerning light-houses, transmitted to Speaker of House. 391
Report of the Fifth Auditor about Light-house Establishment. 292, 392
Report of the Trinity Board, in relation to the light at Isle of May. 884
Revenue boats, list of officers in command of. 37
Revenue cutters, officers in command of, order to, affording facilities to Navy Commissioners. 36
Revolution of light can be set for either than a fixed one. 737
Roane, Marsh's light-house, abandoned. 313
Robb's reef, correspondence about the location of a light-house at. 267
Robbin's Reef light-ship, building of. 20
<table>
<thead>
<tr>
<th>INDEX.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robbin's reef, New York harbor, number of reflectors in comparison with other light-houses</td>
<td>882</td>
</tr>
<tr>
<td>Rockport, breakwater needed to make a good harbor</td>
<td>378</td>
</tr>
<tr>
<td>Rock light-house, description of</td>
<td>484</td>
</tr>
<tr>
<td>Rodgers, H., letter from, about condition, &amp;c., of light-houses</td>
<td>745</td>
</tr>
<tr>
<td>Romain light, not of sufficient range</td>
<td>659</td>
</tr>
<tr>
<td>Romer beacon, explanation about</td>
<td>306</td>
</tr>
<tr>
<td>Romer beacon, white color for, suggested</td>
<td>791</td>
</tr>
<tr>
<td>Romer shoal, correspondence about location of a beacon at</td>
<td>267</td>
</tr>
<tr>
<td>Romer shoal, New York, appropriation for a light-house at, insufficient</td>
<td>538</td>
</tr>
<tr>
<td>Romer shoal, plan and estimate of a beacon at</td>
<td>19</td>
</tr>
<tr>
<td>Rondout light, Hudson river, description of and report on</td>
<td>220</td>
</tr>
<tr>
<td>Root river, the erection of a revolving light on, suggested</td>
<td>87</td>
</tr>
<tr>
<td>Routine, and not improvement, becomes the order of the day under one person</td>
<td>1023</td>
</tr>
<tr>
<td>Rules and regulations for the light-house service, act ordering</td>
<td>901</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine bar, Texas, light-house with 1st-order lens proposed to be built</td>
</tr>
<tr>
<td>Sabine pass, no light-house at, needed</td>
</tr>
<tr>
<td>Saddleback ledge, light-house on, suggested</td>
</tr>
<tr>
<td>Saddleback light-house, description of</td>
</tr>
<tr>
<td>Saginaw, no preparations had been made for erecting authorized light-house buildings</td>
</tr>
<tr>
<td>Saginaw river, description of a light on, very necessary</td>
</tr>
<tr>
<td>Sailing directions, placing of vessels, &amp;c., requires naval officers</td>
</tr>
<tr>
<td>Sail rock, off Quoddy head, light-house and fog-bell of West Quoddy head</td>
</tr>
<tr>
<td>Salaries of light-house superintendents and keepers</td>
</tr>
<tr>
<td>Salem harbor rapidly filling up</td>
</tr>
<tr>
<td>Salmon River light-house on Port Ontario, report about</td>
</tr>
<tr>
<td>Saltpetre on walls, causes of</td>
</tr>
<tr>
<td>Sambo's shoal, Fla., beacon needed</td>
</tr>
<tr>
<td>Sambree, a double light suggested</td>
</tr>
<tr>
<td>San Diego, Cal., contract for light-house at</td>
</tr>
<tr>
<td>Sand Island (near Mobile point) light-house, higher elevation and 1st-order lens suggested for</td>
</tr>
<tr>
<td>Sand Key shoal, near Loggerhead key, Fla., beacon for, suggested</td>
</tr>
<tr>
<td>Sand key, west, should be designated by a light-boat</td>
</tr>
<tr>
<td>Sands Point light, description of and report on</td>
</tr>
<tr>
<td>Sand Shoal island, Va., light-house to be built</td>
</tr>
<tr>
<td>Sand Shoal island, title not satisfactory</td>
</tr>
<tr>
<td>Sandusky island, report about</td>
</tr>
<tr>
<td>Sandusky light-house, description of improvement at</td>
</tr>
<tr>
<td>Sandusky light, explanation about</td>
</tr>
<tr>
<td>Sandy hook, building a floating light off</td>
</tr>
<tr>
<td>Sandy Hook light-house, best masonry in the old light-house tower of</td>
</tr>
<tr>
<td>Sandy Hook light, letter of Lieutenant Porter about</td>
</tr>
<tr>
<td>Sandy Hook light-vessel, expenses for maintaining</td>
</tr>
<tr>
<td>Sandy Hook main light, description of</td>
</tr>
<tr>
<td>Sandy Neck shoal, screw-pile beacon suggested</td>
</tr>
<tr>
<td>Sandy point in Lloyd's harbor, erection of a light-house on, recommended</td>
</tr>
<tr>
<td>Sankaty Head light, description of</td>
</tr>
<tr>
<td>Sankaty head, Nantucket, light-house has been built</td>
</tr>
<tr>
<td>Sankaty head, superior in point of brilliancy</td>
</tr>
<tr>
<td>Santa Cruz, Cal., a light-house at, to be erected</td>
</tr>
<tr>
<td>Sapelo island, Ga., beacon and buoy required at</td>
</tr>
<tr>
<td>Sapelo island, Ga., description of</td>
</tr>
<tr>
<td>Sapelo island, Ga., no light-house on, suggested</td>
</tr>
<tr>
<td>Sapelo Island light-house, Ga., higher elevation and 1st-order lens suggested for</td>
</tr>
<tr>
<td>Sangerties light, (Hudson river,) description of and report on</td>
</tr>
<tr>
<td>Sauk river has but little water, at present no light necessary</td>
</tr>
<tr>
<td>Saving, amount of, by introducing the lens apparatus</td>
</tr>
<tr>
<td>Scientific knowledge, practical, necessary to a director of Light-house Establishment</td>
</tr>
<tr>
<td>Scituate harbor, dry at low water</td>
</tr>
<tr>
<td>Scituate light, a cause of frequent shipwrecks</td>
</tr>
<tr>
<td>Scituate light-house, more or less ruin, requires rebuilding</td>
</tr>
</tbody>
</table>
INDEX.

Scituate light, refitted with improved lantern ........................................ 285
Scotland, general description of light-houses in ........................................ 490
Scotland Light-house Board, deriving their means from light dues ........................ 672
Scotland, organization of the Commissioners of Northern Lights of .................. 488
Scotland, report of expenditures of Commissioners of Northern Lights ......... 493
Screw moorings for buoys, light-houses, and beacons, suggested .................. 375
Screw mooring, Mitchell's patent, description of ......................................... 527, 530
Screw mooring, Mitchell's patent, testimonials ............................................. 528
Screw moorings, the use of, highly recommended .......................................... 805
Screw pile and pneumatic pile, combination of ............................................ 846
Screw-pile beacon, cost of, in England ....................................................... 473
Screw piles, letter of Alex. Mitchell & Son about use of ................................. 802
Screw piles, notes about use of, in construction of light-houses in England ....... 804, 839
Screw-pile structures, vibration observed by .................................................. 803
Screw piles, the use of, recommended ........................................................... 457
Screw piles, the use of, in England ............................................................... 473
Screw piles, W. Cubett about the use of ....................................................... 804
Sea-coast light, defective in power and range .............................................. 873
Sea-coast lights, list of, which require to be elevated and fitted with 1st-order lenses ................................................................. 711
Sea-coast light placed without regard to divergency .................................... 873
Sea-coast lights proposed to be built with 1st-order lens ............................... 711
Sea-coast lights, two keepers necessary for ................................................... 590
Sea water and sea sand, used in mortar, producing saltpetre ....................... 699
Sea water not to be used in making mortar .................................................. 697
Sea water, objectionable for making mortar, proved by Vient ................................ 698
Secretaries of the Board the proper organs of communication .......................... 905
Seguin's island, fog-bell, description of .................................................... 372
Seguin's Island light-house, Me., higher elevation and 1st-order lens suggested for ................................................................. 711
Seven-keel iron cointing about light-house plans for .................................... 781
Ship shoal, La., floating light to be built ...................................................... 532
Ship shoal, La., light-vehicle has been built ............................................... 537
Ship island, Miss., land title unsatisfactory .................................................. 537
Shorter's island, the erection of a small light recommended ............................ 138
Shot Key light, English, much superior to any on our coast ............................ 755
Siasconset, Nantucket, a light-house at, required ......................................... 349, 377
Signals, suggestions for the improvement of light-house ................................ 726
Signal, sound used for ...................................................................................... 752
Signals, telegraphic, between ships at night ................................................. 750
Signals, universal dictionary of ................................................................. 739
Silver creek, description of .............................................................................. 82
Silver creek, report about improvements at .................................................... 156
Sites for light-houses to be examined and surveyed ....................................... 141
Skerryvore light-house, operations for building foundation of .......................... 846
Skilligalae rock, Lake Michigan, will be examined for erection of a light-house .... 540
Smith's island, Cape Charles, light-house, higher elevation and 1st-order lens suggested ................................................................. 615
Smith's island, revolving light suggested ....................................................... 752
Smith's Point light, Va., discontinuance recommended ..................................... 392
Smoke, tendency of a wheel to .......................................................................... 346
Sodus Bay light-house, report about .............................................................. 160
Soldier key, Fl., or Key Biscayne, light-house on ............................................ 30
Sombrero key, Fl., a fixed light suggested for ............................................... 742
Sombrero key, Fl., a light-house at, recommended .......................................... 30
Sombrero key, Fl., description of ..................................................................... 31
Sombrero shoal, Fl., beacon needed .............................................................. 794
Sound transmitted under water, remarks about ............................................ 733
South Amboy, the erection of a small beacon-light at, recommended ............... 137
South Bass island, Lake Erie, a light-house at the southwest cape of the, necessary ................................................................. 150
South Black river, east side of Lake Michigan, should be opened .................... 250
South Edisto light-boat, only serviceable for coasting vessels .......................... 739
South Edisto shoals not marked on the chart .................................................. 739
South Foreland high light, description of ....................................................... 470
South Manitou island, a light-house at the south end of, very much wanted ....... 86
South Manitou island, site for a light-house selected ....................................... 247
INDEX.

South Pass, fog-bell needed, five months in the year constant fog .................. 741
South Pass light-house, destruction of ..................................................... 313
South Pass light-house, higher elevation and 1st-order lens suggested for ........ 711
South Port harbor entirely closed .............................................................. 250
South Stack or Holy Head light, (England,) description of ........................... 273
Southwest harbor, a buoy on, needed ......................................................... 44
Southwest Pass light-house, destruction of ................................................ 312
Southwest Pass light-house has settled ...................................................... 741
Southwest Pass light-house, higher elevation and 1st-order lens required ......... 711
Speaking tube in Scottish light-houses ....................................................... 490
Specifications, the construction and material to be used, prepared by contractor 353
Spindles, coast of Maine, should be located in the most frequented channels ... 373
Spindles in Maine, New Hampshire, and Massachusetts, description of ......... 373
Spindles should be built on levelled sites .................................................. 374
Split Rock light-house, Lake Champlain, report about ................................ 169
Spoon island, location of ............................................................................. 47
Spoon island, report against the erection of a light on .................................. 47, 48
Squaw light-house, more or less ruin, requires rebuilding ............................. 358
Stage Neck, the erection of a monument suggested ........................................ 51
Standard rock, Mich., will be examined for a floating bell ............................ 540
Staten island, monument to be erected on the front beach of ........................ 139
Stones of large dimensions to be used in more exposed towers ..................... 694
Stone towers more dumpy than those constructed by brick ............................ 470
Stonington light, description of and report on ............................................. 211
Stonington, removal of the light-house at ................................................... 305
Stony point, (Lake Erie,) a light-house at, necessary ................................. 149
Stony Point (Lake Erie) light, description of and report on ......................... 220
Stony Point light-house, report about ......................................................... 166
Straitmouth Island light-house, more or less ruin, requires rebuilding .......... 358
Streatsmouth Island light-house, the money appropriated for a beacon at Manhattan should be added to the light-house at ......................................................... 74
Stretford Point light, description of and report on ....................................... 215
Stuyvesant light, (Hudson river,) description of and report on ...................... 221
Stuyvesant light, (Hudson river,) swept off .................................................. 312
St. Augustine light-house so badly built that it fell to the ground ................. 95
St. Augustine light-house, Fla., higher elevation and 1st-order lens suggested for ................................................................. 711
St. Clair flats, location of light-ship and placing buoys to mark channel, recommended ................................................................. 252
St. Clemente, Pacific coast, light-house proposed to be built, with 1st-order lens ................................................................. 719
St. Helena island, Port Royal sound, a beacon at, suggested ......................... 70
St. John's river light-house, destruction of .................................................. 312
St. Joseph, a light-house at the entrance of, suggested ................................ 243
St. Joseph, east side of Lake Michigan, light at, in good condition ............... 245
St. Joseph's river, description of ................................................................... 88
St. Joseph's light-house, Fla., discontinuance recommended ......................... 392
St. Mark's harbor, Fla., the light-house at the entrance of, ought to be rebuilt. 243
St. Mark's light-house, explanation about the removal ................................... 314
St. Mark's light-house, higher elevation and 1st-order lens suggested for ....... 711
St. Mary river, a light-house near its entrance into Lake Huron, recommended. 251
St. Mary river, or properly strait, navigable for vessels of largest class .......... 251
St. Nicholas, Pacific coast, light-house proposed to be built, with 1st-order lens. 712
St. Simon's island, a new light-house at, recommended ............................... 28, 31
Suconneset shoal and the Horseshoe, a light-vessel should be placed between. 200
Superintendence and inspection of illuminating services in France ................ 519
Superintendence the building of light-houses should be done by an officer of the
United States engineers ............................................................................. 243
Supplies, information in relation to, asked .................................................... 758
Supplies, information in relation to .............................................................. 773
Supplies, mode of procuring and delivering, report on ................................ 641
Supplies, no proper attention paid to their purchase ...................................... 874
Supplies, testing their quality, report on ...................................................... 641
Supply of the Light-house Establishment, mode of ....................................... 541
Supply vessel, one not sufficient, therefore two suggested ............................ 393
Suspension of light on Hudson river when navigation is closed by ice .......... 220
Surveys, preliminary, to determine site for a light-house, act in relation to .... 557
Swash channel, New York harbor, range beacons for, recommended .......... 786
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swash channel, range beacons for, suggested</td>
<td>792</td>
</tr>
<tr>
<td>System, a general want of, in every part of the Light-house Establishmen...</td>
<td>870</td>
</tr>
<tr>
<td>System of present organization to be improved, report of Committee of Commerce</td>
<td>125</td>
</tr>
<tr>
<td>Systems of the Light-house Establishment works admirably—opinion of Senator Fessenden</td>
<td>890</td>
</tr>
<tr>
<td>Tailor’s Reef, buoy on, recommended</td>
<td>39,43</td>
</tr>
<tr>
<td>Tall point, between Grassay. Green bay, a light-house at, recommended.</td>
<td>248</td>
</tr>
<tr>
<td>Tampa bay and Cape Henry, additional light-houses between</td>
<td>28</td>
</tr>
<tr>
<td>Tampa bay, a new light-house at the mouth of, recommended</td>
<td>28</td>
</tr>
<tr>
<td>Tarpaulin Cove harbor, a buoy in</td>
<td>193</td>
</tr>
<tr>
<td>Tarpaulin Cove light, description of and report on</td>
<td>193</td>
</tr>
<tr>
<td>Tarpaulin Cove light-house, more or less ruin, requires rebuilding</td>
<td>308</td>
</tr>
<tr>
<td>Tarrytown, North river, New York, light-house to be built</td>
<td>534</td>
</tr>
<tr>
<td>Teller’s point, Hudson river, the erection of a light-house at, not recommended</td>
<td>227</td>
</tr>
<tr>
<td>Teller’s point, North river, New York, light-house to be built</td>
<td>534</td>
</tr>
<tr>
<td>Testimonials of shipmasters, &amp;c., to prove the satisfaction of our light, &amp;c.</td>
<td>863</td>
</tr>
<tr>
<td>Testimony, value of, Thacher’s island (Mass.) light-house</td>
<td>883</td>
</tr>
<tr>
<td>Thacher’s island (Mass.) light-house refitted with improved lantern</td>
<td>711</td>
</tr>
<tr>
<td>Thomas’ Point light-house, explanation about the removal of</td>
<td>285</td>
</tr>
<tr>
<td>Thomas’ Point light-house, number of reflectors in comparison with other light-houses</td>
<td>313</td>
</tr>
<tr>
<td>Throg’s Point light, description of and report on</td>
<td>220</td>
</tr>
<tr>
<td>Thunder Bay Island (Lake Huron) in danger to be underwashed</td>
<td>245</td>
</tr>
<tr>
<td>Thunder Bay island light, report of</td>
<td>86</td>
</tr>
<tr>
<td>Tibbet’s Point light-house, St. Lawrence river, report about</td>
<td>167</td>
</tr>
<tr>
<td>Tide light should only be lighted at half flood and extinguished at half ebb</td>
<td>369</td>
</tr>
<tr>
<td>Timber, danger of conflagration, the main objection to the use of</td>
<td>690</td>
</tr>
<tr>
<td>Titles of the lands or sites for public buildings, &amp;c., to be examined by Attorney General, law for</td>
<td>283</td>
</tr>
<tr>
<td>Torch light superior to Argand lamps contrary to all reason and experience</td>
<td>881</td>
</tr>
<tr>
<td>Tortugas, light at, needs reforming</td>
<td>96</td>
</tr>
<tr>
<td>Totten, Major General J. G., resolution of the Board expressing the great loss sustained in the death of</td>
<td>1024</td>
</tr>
<tr>
<td>Towers and buildings defective</td>
<td>872</td>
</tr>
<tr>
<td>Transfer of the Light-house department to the Engineer department, letter of Fifth Auditor in reply to the</td>
<td>302</td>
</tr>
<tr>
<td>Transfer of the Light-house Establishment to the Navy Department, report of Light-house Board on proposed</td>
<td>1007</td>
</tr>
<tr>
<td>Transfer of the Light-house Establishment to the Topographical Corps, adverse report of the Committee on Commerce</td>
<td>334</td>
</tr>
<tr>
<td>Triangle shoal, Fla., description of</td>
<td>31</td>
</tr>
<tr>
<td>Triangle shoal, a light-house on the, recommended</td>
<td>30</td>
</tr>
<tr>
<td>Trinidad, Pacific coast, light-house proposed to be built, with 1st-order lens</td>
<td>712</td>
</tr>
<tr>
<td>Trinity Board, report about</td>
<td>449</td>
</tr>
<tr>
<td>Trinity House Board, London, list of</td>
<td>819</td>
</tr>
<tr>
<td>Trinity House lights, nearly all sea-coast lights</td>
<td>879</td>
</tr>
<tr>
<td>Trudy’s Outer reef, buoy on, recommended</td>
<td>39</td>
</tr>
<tr>
<td>Truro, Cape Cod light-house, construction of</td>
<td>358</td>
</tr>
<tr>
<td>Truro, Cape Cod light-house has been built</td>
<td>535</td>
</tr>
<tr>
<td>Truro, Cape Cod light-house, Mass., higher elevation and 1st-order lens required</td>
<td>711</td>
</tr>
<tr>
<td>Tube-glasses, wicks, buffkins, and whiting supplied by oil contractor</td>
<td>532</td>
</tr>
<tr>
<td>Turtle island, Lake Erie, description of</td>
<td>25</td>
</tr>
<tr>
<td>Turtle island, Lake Erie, light-house, Maumee bay, explanation about protection against washing of</td>
<td>314</td>
</tr>
<tr>
<td>Turtle island, Lake Erie, report of the light-house at, suggested</td>
<td>71</td>
</tr>
<tr>
<td>Turtle island, Lake Erie, report in relation to protection against washing away</td>
<td>72</td>
</tr>
<tr>
<td>Turtle island, Lake Erie, light-house, report about</td>
<td>169</td>
</tr>
</tbody>
</table>
INDEX.

Twin rivers, description of ........................................ 87
Two-mile ledge, a buoy on the eastern edge of, recommended ........................................ 202
Tybee island, Ga., light-house, higher elevation and 1st-order lens suggested for .................. 615, 710
Tybee island, Ga., a light-vessel off the knoll near, has been built .................................... 537
Tybee light, at Savannah, refitted with improved lantern ..................................................... 285
Tybee light-house, number of reflectors in comparison with other light-houses ......................... 882
Tybee light, steam fog-whistle at, suggested .......................................................... 740

U.

Upper jetty, Cape Fear river, appropriation for a light-house at ............................................ 779
Upper jetty, Cape Fear river, light-house to be built ....................................................... 533
Upper jetty, Cape Fear river, no beacon to be built at ..................................................... 536
Upper Muskeg, West Quoddy bay, a spindle at, suggested .............................................. 91

V.

Van Buren harbor, against the erection of a light-house at ................................................ 58
Van Buren harbor, description of .......................................................... 82, 156
Van Buren harbor, erection of a light-house recommended ................................................. 157
Ventilation, character of the ................................................................. 639
Ventilation in English light-houses ................................................................. 477
Ventilation in the light-houses insufficient .......................................................... 632
Visibility of light, comparison of American and French lights ........................................... 326
Visibility of light, distance of, greatly exaggerated by Fifth Auditor .................................. 879
Visibility of light, given by Fifth Auditor, not correct .................................................. 354
Visibility of light over surface of water greatly increased ................................................ 1092
Visibility, rule for determining the distance ...................................................................... 354

W.

Waugoshance, a light-house at, most urgently required ..................................................... 246
Waugoshance or Fox point, Mich., report recommending the erection of a light-house near ........ 78, 79
Warwick Neck light, description of and report on ............................................................. 205
Watch Hill light, description of ................................................................. 93, 156
Wells' Harbor and beacon-light, at the entrance of, suggested ............................................ 376
Wells' river, pier of masonry recommended ..................................................................... 377
West bay, Long Island, a light-house at, suggested ............................................................ 614
Western Sister island, a colored light should be placed on .................................................. 84
Westport harbor, description of .............................................................................. 201, 201
Westport harbor, the erection of a light-house at, recommended ..................................... 201
West Quoddy bay, description of ................................................................................. 91, 91
West Quoddy Head fog-bell, description of ................................................................. 92, 371
West Quoddy head, light-house and fog-bell at, should be removed ...................................... 92
Whalesback light-house, explanation of Fifth Auditor about ............................................. 304
Whalesback Rock light-house, description and construction of ........................................... 357
Whalesback light, number of reflectors in comparison with other light-houses ................. 882
White Head Island tide fog machine ............................................................................. 371
White island (of the Isle of Shoals) refitted with improved lantern .................................... 385
White river can be made an excellent harbor .................................................................... 250
Wick, carbonization and cooling of the ............................................................................. 362
Wilkinson point, Neuse river, a small beacon-light at, recommended ................................ 28, 32
Wilson and Meacham's plan for illuminating light-houses, appropriation for .................... 556
Wilson and Meacham's plan recommended ...................................................................... 540
Windmill point, the erection of a light-house on, recommended ........................................ 85
Windmill point, Lake Champlain, the erection of a light on, recommended ......................... 169
Wing's Neck, Buzzard's bay, report in favor of building a light-house at ......................... 532
Wing's Neck light-house, Buzzard's bay, has been built ..................................................... 536
Wing's neck, report against the erection of a light-house at ................................................ 52
Wolf Trap shoal, Chesapeake bay, a new floating light built ............................................. 286
Wood's harbor, six buoys in ......................................................................................... 193
Y.

York Ledge beacon, description of ........................................ 372
York ledge, the erection of a monument suggested ......................... 51
York Nubble, report against the erection of a light-house at ............. 50
York river, mouth of, beacon-light required ................................ 376
York river, pier of masonry suggested ...................................... 377
York River Spit light-house at, impracticable and useless .............. 61