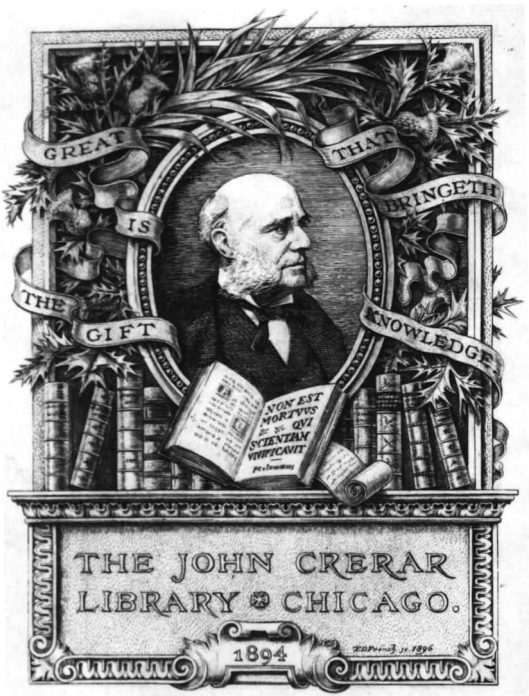
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MARBLE

AND

MARBLE WORKERS,

A HANDBOOK FOR

ARCHITECTS, ARTISTS, MASONS, AND STUDENTS.

BY

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Marmo, bel Marmo.

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PREFACE.

The subject of this work has been my study for the past fifteen years. In the course of my business I have visited the principal European quarries, and have become practically acquainted with the various methods adopted for the raising and working of the material. I have often felt the want of some handy work of reference, which would give me information relative to some particular marble of which I have been in search. I have reason to know that the same feeling has been frequently experienced by architects and others, who are interested in the erection and decoration of our houses and public buildings. This has been the case more especially of late years, when the use of marble as a decorative material has obtained some attention in this country. Early in the present year I contributed several papers upon this subject to the *Building News*. These form the basis of the present work. They have been revised, almost entirely re-written, and added to. In *Marble and Marble Workers* I have endeavoured to condense information obtained with much labour, and contained in voluminous notes, into a form which will be useful to business men. In this endeavour I hope to have been successful.

ARTHUR LEE.

CANON'S MARSH, BRISTOL,
December, 1887.

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MARBLE
AND
MARBLE WORKERS.

CHAPTER I.

INTRODUCTORY.

THE business of raising and working marble has been in active operation for some centuries. When men once learned to build with stone, they speedily discovered that some stones possessed colours and veinings, the beauty of which became apparent when the surface was made smooth; then followed the adorning with polished marbles of stone-built temples, and of palaces, and the building of marble monuments and memorials. A substance which combined great beauty and marvellous variety of colour, with a great amount of resistance to decay, was most suitable for the doing of honour to gods and men, to the living, and to the dead.

Probably the earliest marble-workers were the Ancient Egyptians. Herodotus describes the Great Pyramid as being cased with polished marble, which

gave to the great pile an appearance of dazzling brightness. The Greeks were so fortunate as to discover a pure white marble in the Island of Paros and on the slopes of Mount Pentelicus. It is not too much to say that the unsurpassed excellence attained by the Grecian sculptors was due to this discovery. It provided them with a material which was perfectly adapted for the embodiment of their ideals; which took the most delicate touches of the chisel; and which retained for ages, with all the softness of wax, the mild lustre of the original polish. The power thus given to the sculptor is well described by Gilbert:—

> "Give me a block of senseless marble—Well,
> I'm a magician—and it rests with me
> To say what kernel lies within its shell;
> It shall contain a man, a woman, child,
> A dozen men and women if I will,
> So far the gods and I run neck and neck.
> Nay, so far I can beat them at their trade;
> I am no bungler—all the men I make
> Are straight-limbed fellows, each magnificent
> In the perfection of his manly grace;
> I make no crook-backs—all my men are gods,
> My women—goddesses."

The quarries of Carrara were first worked by the Romans soon after their conquest of Liguria, B.C. 283. At that time Luna fell into their hands. This town was one of the twelve cities of the Etrurians, and was afterwards known as Carrara. Works in marble have not been discovered among Etruscan antiquities, and it may be therefore inferred that the Etrurians did not

know of the quarries. It is also certain that, up to this time, the employment of marble was unknown in Rome. The statues of the gods in the Roman temples were of wood or clay, and the public buildings were of corresponding rudeness.

The result of the Macedonian war worked a great change in Roman taste. The most celebrated works of art found in the captured cities were removed to Rome. In a triumph decreed to M. Fulvius no less than two hundred and eighty statues of bronze, and two hundred and thirty of marble, were exhibited. The bas-reliefs in terra cotta preserved in the ancient temples, which had hitherto attracted veneration, became objects of ridicule. Grecian artists were sought after, and we read that Fulvius Flaccus, the censor, robbed the Temple of Juno Lacinia, in Crotono, to cover one at Rome which he built.

The introduction of marble into private houses is assigned to Sylla. He removed the columns from the Temple of the Olympian Jupiter in Athens to his Palace in the Capitol. The discovery of the quarries of Carrara gave a great impetus to the employment of marble in Rome. The marbles of Luna rivalled those of Greece, and they could be easily transported, from the shores of Liguria, to the mouth of the Tiber. The time when the marble was first brought to Rome is ascertained with tolerable accuracy. Mamurra, in the reign of

Julius, is believed to have first employed it for casing a mansion which he erected on the Celian Mount. Strabo writes that large slabs, and entire columns of marble, were brought from the quarries at Luna. Once commenced, the use of this material, in the Roman city, rapidly spread. It was the boast of the Emperor Augustus, that he found his capital of brick, but that he should leave it of marble.

From Rome, the taste for marble, as a material for the decoration of buildings, spread throughout the civilized world. In our own day, communication between nation and nation has been perfected, and modern architects, and artists, have at their disposal the most beautiful combinations of colours, in a form which will withstand the wear and tear of time.

Marble is a carbonate of lime which is more or less pure, according to the situation in which it was originated. With lime, as a base, and a matrix, the different ingredients with which it has become associated are legion. They have been drawn from the animal, vegetable, and mineral kingdoms—from land, and sea. The fossil marbles of the British Islands are found full of remains of once-living creatures, now cemented together, and hardened into blocks of solid stone. The marine origin of much of the marble found in Ireland, and Belgium, is to be traced in the shells of the crustacea, which are found embedded in the mass. The native

crystallised carbonate of lime, known as Iceland or felspar, is very similar in its chemical constituents to the nearly pure carbonate, which we know as statuary marble. The different conditions under which each material has been formed have given them different appearances and properties.

Experiments made some time ago by Sir J. Hall proved that if carbonate of lime is heated under strong pressure, so as to prevent the escape of the carbonic acid, it may be melted, and the product then appears very much like marble in character and texture. What Sir J. Hall did on a small scale nature did on a large one, when she provided for us the world's store of marble. Carbonate of lime at some time in the history of a particular district was subjected to great heat and pressure, and to-day we find that which we call marble.

Where the lime was pure, or nearly so, we find statuary marble. Where the lime contained streaks of dark colouring matter, we get veined marble. Similarly, we can trace the manner in which all the coloured marbles were produced. Limestone, in close proximity to beds of iron ore, became red ; copper gave us a green, and so on.

The different varieties of marble have been variously classified by different writers; most frequently they have been divided into two great divisions: Primitive marbles of a crystalline character, which have a brilliant

shining fracture; and Secondary marbles, which are compact and close in texture, and which have a dull fracture. It is probable that this division was made with the idea that the first class of marble was more ancient than the second. This is only partly confirmed by geological observations. We occasionally find marble of a highly crystallised form in the more recent formations; on the other hand, we find many marbles which would be classed as secondary amongst the older strata.

Another classification divides marbles into six different varieties:—

1.—*Marbles of a uniform colour*, comprehending solely those which are white and black.

2.—*Variegated marbles*, or those in which the spots and veins are interlaced and disposed without regularity.

3.—*Shell marbles*, or those which are in part made up of shells.

4.—*Cipolin marbles*, or those which are veined with green talc.

5.—*Breccia marbles*, or those which are formed of angular fragments of different colours united together by a cement.

6.—*Pudding-stone marbles*, which are like breccia marbles, except that the pebbles are rounded in place of being angular.

Perhaps the most interesting mode of division is to classify the various marbles under the names of the

countries in which they are produced. This is especially the case when the object is to avoid ground which has been trodden before, and the commercial aspect of the question, rather than its strictly scientific, or geological side, is to be dealt with. In the following chapters, it will be sought to give descriptions of the different marbles which are produced to-day, of the places from whence they are procured, of the people who quarry and who work them, and of the tools and machinery which the marble-worker employs.

Chapter II.

ITALIAN MARBLES.

THE Italian marble trade is of considerable importance. It centres in Carrara, and in the neighbouring towns of Massa and Serravezza. The annual production of this district is about 170,000 tons, representing a money value of over a million sterling. Upon this the Italian goverment takes toll to the extent of £17,000 a year, in the shape of a direct tax of 10 centesimi (a penny) on every cubic palm raised. A palm measures in length 9·81-in., and is to the Italian quarrymen what the foot is to the Englishman. Four cubic feet equal rather more than seven cubic palms; the exact equivalent being 1 to 1·81.

The whole range of the Apennines is singularly rich in deposits of marble; but the white marble found at Carrara, and known all over the world, is the most famous. The name Carrara is derived from the Latin *quarrarie*, whence our English word quarry. The people of the town are exclusive; they speak a sort of language or patois of their own, dignified by the name of Carrarese. Human life is not set at so high a value

as it might be, stabbing affrays being lamentably frequent; but it is of almost unknown occurrence to hear of mischief to the stranger within the gates. The numerous studii, and workshops, are like so many cellars built on the street level, under the dwelling-houses. They admirably answer the purpose of being shady and cool to work in, but afford no opportunity for the sculptor to display his handiwork. A small stream runs through the centre of the town, and affords the motive-power to sawmill after sawmill. In the Academy, there is a large collection of models and casts from the greatest works in sculpture—ancient and modern. From sixty to seventy pupils, who are taught drawing and modelling, are regularly in attendance.

The marble, when brought from the quarries, is conveyed to the seashore at Avenza, which is about five miles distant from Carrara. It is sent thence to Leghorn in small coasting vessels called "navicelli." From Leghorn it is exported to all parts of the world. A considerable saving would be effected if seagoing ships could load at Avenza itself. At present there is the cost of transportation to another port, and the consequent double handling. It is quite practicable to make a good harbour; but hitherto local enterprise has contented itself with building a pier, from which the small craft are loaded. A railway connects the pier with some of the quarries; but the bulk of the traffic goes the old

way, by road, and on bullock waggons. The journey down is a slow and terribly toilsome process. A team of bullocks takes a whole day to complete a single journey, from the quarries to the seashore; the mountain road is more like the bed of a torrent than a beaten track.

The quarrymen are a prodigiously hard-working race of men. In the summer it is too hot for them to work in the middle of the day; but long before the day breaks, they commence their ascent of the mountains, and climb three, five, and some of them six miles, before they reach the scene of their labours. When the sun is high enough to force them to retreat they have done a good day's work, and a long march home in the burning heat is before them. These men earn wages which average some 15s. a week: they are paid fortnightly. Not being a thrifty race, a good portion of the scanty wage goes in liquor and the lottery, and nature is kept going till next pay-day on a fare in which a miserable black bread is the principal factor. The men work in gangs. Each gang is under the control of a head man, who agrees with the owner of the quarry to get out the marble at a fixed price per cubic palm. The getting of the marble is dangerous work. The quarries are just so many openings cut in each side of the valleys into the mountains. The blocks are loosened from their beds, by the ordinary process of blasting,

and are then suffered to slide down, by their own weight. As they fall down the mountain side, large fragments are knocked off them right and left, and this rough usage is the cause of many of the flaws, and vents, which are afterwards developed in the working.

The quarries worked in the Carrara district are some 550 in number, of these 70 are at Massa, and 100 at Serravezza, Stazzema, and Pietra Santa, and the remainder in the near neighbourhood of Carrara itself.

The number of workmen engaged in the trade in the year 1884, according to the official returns of the Italian government were as follows :—

	Carrara.	Massa.	Serravezza.	Total.
In the quarries ...	3600	750	680	5030
In transport ...	600	80	180	860
In the sawmills ...	650	150	360	1160
In the studii	950	200	260	1410
	5800	1189	1480	8460

The average wages paid to the different classes of workmen are : quarrymen, per day, 2s 6d ; gangers or foremen, 4s ; masons, 2s 9d ; sanders, 2s 9d.

Of sculptors there are all grades, from the ordinary carver whose services can be obtained for 3s 6d a day to the master in the art—the professor — who has received rewards and decorations from crowned heads, and who is sought after with commissions from every

part of the world. The quarries are situated in the ravines, or gorges, which run up between the lofty peaks of the Apennines. At Carrara these mountains are about 1500 feet in height, and from their summits a magnificent view can be obtained of the plain below, and of the Mediterranean in the distance. The white marbles of Carrara are known to the English market as Sicilian, Vein, and Statuary. Of these, Sicilian is the most common. The term "Sicilian" is purely English, and is of doubtful origin. It has been asserted that the first cargo brought to England arrived in the good ship *Sicilia*. More probably, however, the marble is so called because it was formerly shipped to Sicily, and thence to an English port. The Italians call it Bianco Chiaro (clear white). It varies much in colour and in texture as it approaches more nearly to the character of Vein on the one hand, or of Dove on the other. The principal quarries are situated in groups, known as the quarries of Lorrano, Canal Bianco, Canal Chiosa, La Rattola, and Ravaccione, in the ravine of Ravaccione; of Fantiscritti and Canal Grande, in the ravine known by the latter name; and of Collonata.

The pure appearance of white marble has caused it to be much used in the raising of memorials to the dead. For this purpose Sicilian is chiefly employed. It is, in fact, the only white marble which will bear exposure to the open air. The others are much softer,

and liable to speedy disintegration, if placed out of doors. Very great care is, however, necessary in the selection of Sicilian which will withstand a Northern climate. The best is of a slightly bluish tint, of hard and close texture, of uniform colour throughout, and free from decided veins. Vein marble is used for decorative purposes in the interior of buildings; it is of much whiter ground than Sicilian, is softer, and becomes more or less valuable as the veining is more or less fine and regular. The principal quarries are those of the group known as Vara, and Canal Piccola, in Canal Grande, and of Gioja, in Collonata.

Statuary needs no description. It is the most beautiful, and the most sought-after, of all marbles. The great difficulty about it is that a block can be rarely obtained which is pure. The principal quarries are in Ravaccione, near Carrara. The best is of even white tone, with a slightly yellowish tint. Some of it is of a sugary whiteness, which takes the eye of the inexperienced; but is quite unfit for sculpture. Statuary of this description is soft and easy to work; but is very liable to stains and rapidly falls into decay. A very beautiful description of Statuary is found near Serravezza. It is much whiter than that of Carrara, but is somewhat coarser in grain, and is perhaps, on the whole, not so well fitted for the sculptor as the latter.

Some of the quarries in Canal Grande, and Collonata, produce a marble of a dark blue tint with veinings, which are little to be distinguished from the ground colour. This variety is known in England as Dove marble. It is very hard, and is little used.

A marble of similar character, but of much greater beauty, is known as Bardilla or Bardiglio. It is found at Serravezza. It is of a pale dove ground traversed by dark veins; sometimes the veining assumes the appearance of flowers, hence the Italian name for it of "Bardiglio fiorito" or "Fiorito di Serravezza."

Another very fine marble found in this neighbourhood is called Serravezza Breccia. This is known in the French market as "Fleur de Pêcher" on account of its dominant colour. It has been employed in the decoration of the Paris Opera House, and it has been recently specified for use in the new Municipal Buildings at Glasgow.

The quarries in the valley of Stazzema, near Pietra Santa, produce some greenish white Cipolin marbles known as Pietra di Volegna. They are rarely found of compact texture, and are variable in colour, but the blending of the green and white tints very often produces a beautiful effect.

Pavonazzo marble is raised near Carrara. It is of very rich colour; the ground varies from a creamy white to a yellowish brown, marked with deep purple

veins, with here and there a greenish tinge. It is much used for panellings of walls. When employed for this purpose and used in large masses, it has a magnificent appearance.

Siena marble is found near the town of that name, the ancient Sena Julia on the Via Clodia. This marble is of a deep, rich yellow tint, with veinings of purple and black. The quarries do not seem to have been properly opened up. They are so many scratches on the side of the mountains, and very few large blocks are produced. In Italy it is usually sold by weight.

The quarries from which Black and Gold marble is procured are at Porto Venere, near the mouth of the Gulf of Spezia. This marble is sometimes known as "Portor" marble. This is a corruption of the Italian Port d'Oro. The ground is of a rusty black, with spots of light brown. The veining is very beautiful, running from white through every shade of yellow to dark brown.

Near the coast, between Spezia and Genoa, there are several quarries of coloured marble. At Levanto, two varieties are raised—the Rosso, and Verde di Levanto. The first is a purplish-red marble; in the latter, veins of purple, red, and green are mixed and interlaced in a most bewildering manner. At Pietra Lavarezza, near Genoa, the beautiful Genoa-green marble is produced. This marble has a very deep green ground; in places

it is almost black. It is filled with a veining of a lighter green and white. Another very handsome green marble, called Verde di Pegli, is found near Genoa along the course of the Varenna torrent.

This district also produces the marble known as Verde Antique. It is very similar in character to the other green marbles of Genoa, but it can generally be depended upon as being comparatively sound and fairly easy to work.

A very beautiful serpentine, called Verde di Prato, is quarried near Prato, a small town a few miles from Florence. The ground is of a deep green, with dark spots, and veined with white. It polishes well, and is cheap; but it cannot be obtained in large blocks, and it is not the most durable of marbles. A great deal of it has been used in buildings at Florence. It is especially to be noticed in the Cathedral, the Campanile, and the church of S. Maria Novella. In these buildings it has been employed in the exterior walls, with alternating courses, of white marble and red sandstone. The effect is striking, and very beautiful; but much trouble has been caused, by the gradual decay of the serpentine. The use of it should be entirely confined to interiors. A good example of it can been seen in this country, in the new portion of the National Gallery in Trafalgar Square, where it has been used in the moulded plinths of the exhibition rooms and the staircase.

There are several quarries of a finely-marked red marble in the hills to the north of Verona, the town immortalised by Shakespeare in his story of the loves of Romeo and Juliet, and the contests between the Montagues and the Capulets.

> "Two households, both alike in dignity,
> In fair Verona, where we lay our scene."

The tomb of Juliet is one of the attractions of the place, and it is built of the red Verona marble. This is of a pale pink ground, with veins of red and dashes of grey. It sometimes assumes a brecciated aspect. The marble is not very hard, but it takes a good polish. It has been extensively used in the buildings of Venice. In the palace of the Doges it is found in the columns on the south and west sides; and it has also been employed at St Mark's, in the Accademia delle Belle Arti, and in several of the Venetian churches.

Near Lago Maggiore there are some quarries of a white marble, which was used in the construction of the cathedral at Milan. In the same neighbourhood, at Baveno, on the shores of the lake, there are some large quarries of a very fine granite; this is principally worked upon the spot, very little being sent away in a rough state.

There are several varieties of Italian alabaster. A very beautiful pure statuary is found in the Val di Marmolago, near Castellina. Another, known as agate

alabaster, is quarried near Volterra. A fine clouded variety, called Bardiglio, is also found near this town, which is the seat of the Italian alabaster trade. There is an enormous business done in this material. There is hardly a piece of sculpture of which a model can be obtained, which has not been reproduced by the sculptors of Volterra. So much of it has been turned out in modern times that its value has been sensibly depreciated. It is somewhat fragile; but the beauty of its appearance, and the ease with which it can be worked, will always keep it in demand.

The stowage of marble, as practised at Leghorn, is raised to the dignity of a fine art. Generations of stevedores have inherited, and have improved upon, the traditions of their fathers. The loading of the large ocean-going vessels from the small navicelli is very smartly done. A floating pontoon crane is brought into play, in which the required power is gained by means of a huge wheel. In this manner the heaviest blocks are lifted from the small vessels, and are delivered into the holds of the large craft without difficulty. The cargoes are usually made up with light goods, of which pumicestone, hemp, oil, and sumac form the principal part. Of these, neither hemp nor pumice are sources of trouble; but it is necessary to keep oil and sumac from all contact with marble. Sumac is especially dangerous. It is shipped as a fine floury

substance, and in sacks which are never too stout. When sumac dust settles on white marble, the result is not immediately apparent; but if it once becomes wet, or even damp, it becomes a powerful purple dye, which penetrates the marble to an extraordinary depth.

Italian marble is usually shipped and freight paid by measurement, and not by dead weight, 25 cubic palms, or about $13\frac{1}{3}$ cubic feet being reckoned to the ton.

The principal market is the American. About one fourth of the total production of the Italian quarries is shipped to the United States and to Canada. France takes some 25,000 tons annually, Great Britain 18,000, and Belgium 5,000. Russia and Germany are also large importers of Italian marble. Sawn slabs are principally shipped to England—in fact, this is now the only country which admits them duty free. As a consequence, the market price of sawn Italian marble is lower in England than in any other part of the world, except in Italy itself, and sometimes not even with that exception.

Chapter III.

BRITISH MARBLES.

THE trade in British marble is considerable; but it is not a tithe of what it might be. Demand and supply are both in existence. The demand for coloured marbles for the English market is strong enough to cause large importations from France and Belgium, while at the same time there is an inexhaustible supply of the raw material within the confines of the British Isles. It is a most curious fact that in times when there is great difficulty in finding profitable employment for English capital, so little of it is directed into this particular industry. When we examine the trade of the two continental nations mentioned, we shall find that it has been developed to enormous proportions. Both French and Belgians have shown persistence and energy in securing a market for themselves in this country. They have done so successfully in spite of the fact that many of the British marbles are of exquisite beauty, and equal to anything which can be obtained by seeking fields afar. It is much to be regretted that the bulk of the coloured marbles used

in England find no employment for home labour. One of the reasons assigned for the present state of affairs is that the British railway charges effectually destroy all chance of largely developing the home industry. There is much truth in this assertion. The iniquitous system by which the railway companies favour the foreigner has worked with full effect upon the marble trade. British marble sawn into slabs and carried from London to Bristol is charged 27s 6d per ton. Foreign marble slabs are carried between the same towns for 20s. If the lower rate pays in the one case it certainly should pay in the other. If the lower rate does not pay, the foreigner is practically subsidised at the expense of the home producer. The British quarry owner has not only to contend against the preferential rate given to his foreign rival, but he is seriously handicapped by the enormous rate which the British railways charge him, as against those charged in Belgium, and in France, for the same class of traffic. The rate charged for carriage of a rough block of marble between London and Bristol, 118½ miles, is 12s 6d per ton. In Belgium the same block would be carried 124 miles for 4s 5d per ton. It should be remembered that the cost of rough blocks of British marble at the quarries range from 2s to 6s per cubic foot, or from 24s to 72s per ton. When this fact is taken into consideration it will be seen what an enormous percentage in cost is caused by a difference of

a few shillings per ton in carriage. This is a grievance which is felt and bitterly resented by British marble workers, who, as yet, have found no remedy.

In spite of these disadvantages, the home production increases. The marbles of Devonshire especially have been much used of late years. This is, no doubt, owing to the determined efforts of one or two enterprising firms, who have brought them persistently under public notice. It is within the last century that the beauty of Devon marbles has been widely known. In earlier times the smart natives of that county seem to have been unaware that they possessed a natural treasury in coloured limestones which could be profitably turned to account. In the ancient churches which are still in existence in Devonshire, Purbeck marble appears to have been generally employed for decorative purposes. It is now scarcely a century ago since a stranger visiting Plymouth stated that to his mind "Plymouth marbles were more beautiful than any foreign marbles." Sir Henry de la Beche, in his "Report on Devon, Cornwall, and West Somerset," says: "Marbles of very great variety may be obtained, though tints of grey chiefly prevail, and they deserve to be far more extensively employed than they have hitherto been; a greater demand would cause many more varieties to be worked."

From the researches of Mr. R. N. Worth we gather

that the Plymouth marbles are raised from a great band of Devonian limestone about half a mile in width, which extends from the Devonport Dockyard some six and a half miles easterly, to a place called Sherford. Associated with this run of rock is an isolated patch of considerable extent at Yealmpton, and two or three smaller patches of no commercial importance. The rock is crystalline, hard, and durable; massive, as a rule, in its more central portion, and largely fossiliferous.

The chief points at which the Plymouth limestones are now worked—some of the older quarries have been abandoned—are Cattedown, Pomphlett, Radford, Oreston, and Billacombe, and there is practically no limit to the size of the blocks which can be obtained, except the possibility of moving them.

The variety presented by the Plymouth marbles is remarkable. The "figure" of the coralline examples is often exceedingly beautiful especially when the "favositidæ" occur, colloquially called "feathers." Other fossiliferous kinds are picturesquely marked by the sections of included shells. The prevailing colour is grey, of different shades; but short of positive blue there is almost every other tint which can be named. The richest black, self or varied with white, occurs at Billacombe and Pomphlett. At Billacombe, too, there is raised a curiously brecciated variety, largely composed of creamy, semi-transparent calc spar, relieved by

included fragments of reddish-brown rock. Radford includes, among other kinds, a rich rose red of singular purity. A beautiful green marble is found at Kitley. Then there is a delicate dove colour, ranging to lilac; a black with pink veins; grey and dove-spangled, and veined with rose and ruddy brown; a warm chocolate, and a rich yellow, mixed with black, of rare beauty.

The Devon marble found in the neighbourhood of Torquay is also of a very fine character. Amid the romantic scenery near Babbacombe and Marychurch are the Petitor quarries. These are close to the sea-shore. They produce a marble with a dark, cloudy, dove ground, having spots of a fossiliferous character. The Hoppoway quarry is not far off; from it is obtained a light dove marble. At Ashburton there is a quarry which produces a fine, dark, fossil marble, and at Chudleigh a similar marble is found, which has a dark ground, and is less fossiliferous. A very beautiful red and variegated marble is found at Ogwell, and is know by the name of Red Ogwell. At Ipplepen there are quarries of a red and blue marble.

At Torquay a considerable business is done in the manufacture of English marble mosaic. For this purpose the marbles found in the district are employed, together with the madrepores, of which South Devon has an endless variety. The mosaic appears to be used principally for small articles of ornament, and in designs

of which those of a floral character are most common. There would appear to be no reason why the trade in English marble mosaic should not be largely developed. If this can be done, it should take the place of much of that work for which Italian labour is now employed.

The beds of limestone in which Devon marble is found, extend over a considerable district. It is worked in the neighbourhood of Plymouth, and north and east as far as Ashburton, Chudleigh, and Torquay. This district is about eleven miles in breadth at the east, and diminishes to about two miles at the west, near Plymouth. Polwhele, in his "History of Devonshire," states that "there are twenty-four known varieties of Devon marble." Many of these have never been quarried in any quantity. The resources of the county in this respect will bear considerable further development.

At Draycott, in the neighbouring county of Somerset, a conglomerate is raised known as Draycott stone; it will take a fairly good polish, and is in request for altar steps and kindred purposes. The matrix is frequently soft; but the small pebbles and stones contained in it are so hard that the sharpest flint sand and much labour are required to saw and to work it. When properly polished it has a very handsome appearance. It is a breccia of a red ground, with patches of many colours, from a reddish-white to black. Two marbles

—one grey, the other green—are found in the Quantock Hills. Specimens of these marbles are to be seen in the pulpit of St. Mary's Church, Taunton. A bluish-black limestone is found near Street. It takes a fair polish, but it is coarse in grain. In the neighbourhood of Bristol there are deposits of a brown marble which is marked with brownish-black veins. From the peculiar character and form of the marking it is locally known as "landscape stone," from a fanciful resemblance to country scenery which can be traced in it. It takes a good polish, but it is only found in small pieces, and its employment is limited to the manufacture of mosaics and small ornaments.

Purbeck marble is found in the peninsula at the south-east angle of Dorsetshire which is known as the Isle of Purbeck. It has a longer history than that of any other British marble. It was largely used in some of the most venerable ecclesiastical buildings—notably in the cathedrals of Salisbury, Winchester, Worcester, and Lincoln. In the ancient church at Christchurch, there is a beautiful thirteenth-century sacristy of the time of Henry III. The shafts are of Purbeck marble. The same marble was used for the original altar in the Lady Chapel. The top of it is a fine slab 11-ft. long and 3-ft. 10-in. wide. This chapel had been completed by 1406, and probably previous to 1395. The magnificent tomb of Richard Beauchamp, Earl of Warwick,

in the choir of St. Mary's Church at Warwick, is of Purbeck marble. This tomb is inferior to none in England, except perhaps that of Henry VII. It is on record that the executors of the deceased earl covenanted with John Borde, of Corfe, marbler, to make the tomb of fine and well-coloured Purbeck marble, 4½-ft. high from the base, the base 6-in. thick and 18-in. broad, the uppermost stone of the base 9-ft. long, 4 ft. broad, and 7-in. thick; and to have for the marble, carriage to Warwick, and work, £45; for marble tiles to pave the chapel, workmanship, and carriage, 40s per hundred. The whole cost of the chapel and tomb came to £2841 : 4 : 7, an unusual sum in days when the price of an ox was 13s 4d, and wheat was selling at 3s 4d per quarter.

Hutchins, in his "History of Dorset," written in 1724, tells us that "in Purbeck there was formerly dug marble of several colours—blue, red, spotted, and grey, but chiefly the latter; all of a coarse sort. The grey is a congeries of shells—vast quantities are found in all our ancient churches, parochial, conventual, and cathedral—and it was in great repute for gravestones and monuments. At Swanwick (now spelt Swanage) is a white stone full of shells which takes a polish and looks like alabaster; there is another of the same sort, but not so hard."

The only marble which has been raised in Purbeck

of late years is of a dark greenish-grey colour with a purplish tint. The quarries are near Corfe Castle. The great demand for the marble which existed in more ancient times seems to have fallen off. One quarry was in work until a few years ago, but that is now at a standstill; the cost of Purbeck marble and the difficulty of obtaining it in large blocks have been against it. The objection on account of cost should now be removed. It was principally caused by transport difficulties, but the railway which has been opened to Swanage should make matters more easy upon this score; blocks of Purbeck marble can now be put on rail at Corfe Castle, not far from the quarries. This should enable the owners to bring the marble once more upon the market.

In the island of Anglesea, near Penmon Priory, about four miles from Beaumaris, there are some quarries which produce a finely-marked marble of a light brown ground, covered with spots and veining of a darker tint. This is known as Anglesea marble. It is fairly sound, easy to work, and the blocks run to a large size. It has been used in the neighbourhood of the quarries for monumental purposes; but the decided marking of the stone interferes with the effect of an inscription. The feature is, however, of service in many architectural compositions. Anglesea marble has been employed with success in the internal decorations of the Liverpool Conservative Club and of the Walker Art Gallery.

Small quantities of a fine black marble have been found in the workings at Penmon, but it is not yet known to what extent the deposits exist.

Some years ago a fine green marble was raised in Anglesea, many specimens of which are in existence. Writing in 1733, Thomas Pennant says:—"On the coast of Anglesea is Kemlyn Bay, where there is safe anchorage for small vessels. Not far from hence I saw the noted quarry of marble, common to the place, some parts of Italy, and to Corsica, and known in the shops by the name of Verde di Corsica. Its colours are green, black, white, and dull purple, irregularly disposed. In different blocks one or other of the colours are frequently wanting, but among the green parts are often found narrow veins of a most elegant and silky white asbestos. It is a compound species of marble—part is calcareous, and may be acted on by aquafortis. The green parts partake of the nature of jasper. It is apt to be intersected by small cracks, or by asbestos veins, and is, therefore, incapable of taking a high polish. The quarry lies on the lands of Monachty, in the parish of Llanfairyghornwy, and is found again in the Isle of Skerries off this parish."

There are several important deposits of variously-coloured serpentine found in Cornwall. The principal quarries are found in the Lizard promontory. They are the Signal Staff, near Cadgwith; Treal Quarry, near

Ruan Minor Church; Balk Quarry, Longalley, Killavwn, and Poltesco. The colour of the rock obtained from these quarries is mostly of a beautiful black and rich reddish-brown, except that found at Killavwn, which is jet black. A variety with an olive-green base, striped with greenish-blue veins, is found near Trelowarren. The quarries are generally worked some 60ft. below the surface; the stone is raised without blasting, by means of wedges and lifting jacks. There are few spots around the British coast more beautiful than Kynance Cove; the serpentine rock in all its varied tints is polished by the beat of the Atlantic waves, and is rendered more striking and beautiful by reason of its contrast with the white sands of the shore.

At Duporth, near St. Austell, a stone is raised called Duporth Serpentine. It is a hydrated silicate of magnesia, iron, and alumina, and presents a diversity of greenish tints, relieved by a variety of angular whitish spots; the mottling thus caused has a very charming effect. It resembles Purbeck marble in general appearance, but is of lighter colour and will not take so good a polish. It is cheap, and the ease with which it can be worked is a considerable element in its favour. It can easily be cut with a toothed saw; but, at the same time, the texture is firm enough to preserve an arris sharp and clear. It has been used in the erection of the new cathedral at Truro, and there forms an effective contrast with Bath stone.

Near Petworth, in Sussex, a marble is found known as Petworth marble. It is a shell marble, very similar in appearance to Purbeck. The ground is grey with a shade of green, and the stone is thickly set with shells. Sometimes these shells are filled with a white spar, which variegates and adds to the beauty of the stone. This marble was in former times much employed for architectural purposes. It is to be found in Westminster Abbey, the slender round shafts of the pillars being composed of it. It is also found in the upper arcades of the cathedral churches of Chichester and Canterbury.

Derbyshire marble is found in various parts of the High and Low Peak. It is all derived from carboniferous limestone. A very good black marble abounds at Ashford; but it is also found at Wirksworth, Bakewell, and at Little Longsden. That at Ashford may be obtained in very large blocks; it is of a deep black colour, and of very close and solid texture. It is capable of receiving a particularly high polish. The thickest bed measures 10in. The grey fossil marble, mottled and veined, is found in a variety of places, but principally at the quarries between Sheldon and Flagg. The thickest bed is 9in. This kind of marble is remarkable for the diversity of shade in its prevailing tint, some of it being of a very pale grey colour, and some deepening into a bluish hue. It is rendered very

beautiful by the number of purplish veins which appear upon its polished surface; but its chief ornament is the number of entrochi with which it abounds. The longitudinal and transverse sections of these fossilised creatures produce an almost incredible diversity of figure on each section. In general, the more superficial the bed the lighter is the colour of the marble and the more abundant are the entrochi. Purple-veined marble is found at Ricklow Dale, near Monyash. A variety of the entrochial marble is found between Ashford and Sheldon. This is called Bird's-eye Marble; it is very solid and hard, takes a high polish, and is much used in the district. Besides these calcareous marbles, there is a bed of ironstone eight or ten inches thick, abounding with the impressions of mussel-shells. This is called Dogtooth or Mussel Marble. The vein of this stone runs between grit rocks in the coal district at Tupton and other places in the neighbourhood.

Quantities of alabaster are mined in the county of Derby, but it is seldom sufficiently pure to be employed for ornamental purposes, and is chiefly used in the manufacture of plaster of Paris. A very handsome variety of red-veined alabaster is found at Fauld, near Tetbury, in Staffordshire; it has a rich creamy white ground, and is marked with red and brown veins which interlace over the whole of the surface. A large pedestal and tazza of this alabaster are placed in the

hall of the Museum of Practical Geology in London, and it has been lately used to advantage for balusters to staircases, altar panelling, and the like work.

New England Marble is raised at Stainton, near Dalton-in-Furness. There are two varieties; one is of a light fawn colour, without much veining, the other is of a darker ground, and is marked and veined with purple and brown. The present workings are favourably placed. The Furness Railway Company has a branch line running through them, and the railway-station at Dalton-in-Furness is only one and a half miles distant. The marble is found in some very old work at Holker Hall, the seat of the Duke of Devonshire; but it does not appear to have become generally known until after 1858, since which date the quarries have been vigorously worked. About 100 men are now constantly employed upon them.

Near Frosterley, in Durham, there are some large limestone quarries which produce a dark fossiliferous stone known as Frosterley Marble. The ground is of a very dark-brown, in places nearly black, and full of shells. Frosterley Marble takes a high polish; but it is very hard, and consequently difficult to work.

About five miles from Lazonby, in Cumberland, a deposit of fine black marble has lately come to light. It has not yet been worked; but the deposit is said to exist over a large area, and working would

probably be profitable. The marble could be carted to Lazonby at very small cost, and once there, it is on the Midland Railway system, and distribution becomes comparatively easy.

In the Isle of Man, at Portwash, a black marble is found which was used for some steps in St. Paul's Cathedral. At the same place there is also a shell marble of a grey colour. A black marble, very hard and durable, and taking a good polish, is found at Port St. Mary.

At Tiree, in the Hebrides, there is found a beautiful marble known as Tiree Marble. In colour it is of a pale blood-red, light flesh-red, and reddish-white; with this are mingled crystals of dark green, which appear to belong to a species of the hornblende family; they are mixed in various proportions with the marble so as to produce pale blackish-green, dark asparagus-green, and a colour which approaches leek-green. Very little of this marble is ever seen in England; but there is a good example in the library of the Museum of Practical Geology, in which there is a bust of Sir H. T. de la Beche, which is supported on a block of it.

Several varieties of marble have been found in Scotland; but very little of it is used by the marble worker. The deposits are either of small extent or they are too difficult of access to make working pay. At the present time they are of more interest to the geologist and to the

student than to the architect or the mason. There are deposits of a kind of white marble at Assynt, in Sutherland; the best of it is situated in the bed of the river, about a mile or two south of the church. A white marble is found near Blairgowrie, in Perthshire, not far from the high road towards the north. Another white marble, composed of shining broad grains like spangles, may be seen in the forest of Glenarm; but the situation is remote, and difficult of access. An ash-grey marble of a fine uniform grain and susceptible of a good polish is found at Lochaber. A black variety veined with white is found about three miles south of Fort William; it is of a close grain, but not very hard. A dark brown variety variegated with white is mentioned by Dr. Meek as being quarried in the county of Lanark. There are several slabs of this marble at Hamilton, and a chimney-piece made of it is in the Glasgow College Library.

The varieties of marble found in the Island of Skye are said by Professor Jameson to be as follows:—A white marble veined with ash-grey, very heavy, and will not stand exposure; an ash-grey variety variegated with lemon-yellow stripes, which traverse it in different directions, and which seem to be due to an intimate mixture of hornblende with the marble; and a variety of bluish-grey, which closely approximates in texture to the marble of Carrara.

The marble of Iona is of a greyish-white ground

mixed with yellowish or greenish-yellow spots and veins of steatite, called "Icolmkill pebbles." There is also found in this district a crystalline white marble, a sample of which is placed in the museum of Trinity College, Dublin. A dark coloured shell-marble occurs in the limestone quarries of Cumnertrees, in the county of Dumfries. A good deal of this has been worked at one time and another, and some of it has found its way to London. It is full of shells and petrifactions, and takes a high polish.

Ireland possesses several very valuable deposits of marble, but the trade has always had considerable difficulties in its way. Half a century ago the importation of marble into England and Scotland was practically prohibited by a duty of two shillings a cubic foot. At the present time the trade is severely crippled by lack of railway facilities, and even when these exist, the rates charged for carriage are so high as to materially interfere with the industry. The Kilkenny marble is best known; it has been worked for centuries. It is very close in grain, and takes a high polish. Some of it is pure black, some of black ground, beautifully marked with a great variety of fossils. The principal quarry is situated on a rising ground about a mile from the city of Kilkenny. The marble is procured in large blocks, and a large proportion of it is exported in a rough state. A marble of pure black is found in a quarry about five miles distant.

In the same county of Kilkenny there is also a dark grey fossil marble; it is very sound and uniform in colour, and in the district is largely used for monumental work. It has not been neglected by the architect. A recent example of its application in building construction is to be seen in the restoration of the west front of Wells Cathedral; in this work Kilkenny fossil marble was largely employed. The Kilkenny marble sawing mills bear the distinction of being the first which were established in Great Britain in which any other than hand-power was employed. An ancestor of the present proprietor set up saws worked by water power in the year 1730, and from then until the present time the mill has been constantly at work; it is situated on the banks of the River Nore, about two miles south of Kilkenny, and the business now done is on an extensive scale.

There are several very good marbles found in the county of Cork. Victoria red is a fine-coloured red marble, variegated with light-coloured patches and mottling. A brownish-red marble is also found at Middleton, Churchtown, and Little Island. Another red marble of similar character occurs at Ballymahon in county Longford. In the county of Limerick, at Pallaskenry, there is a dark red and mottled marble: this was once extensively used, but is now little heard of.

Galway is a county rich in beautiful marbles, but the

want of railways does much to check the development of the trade. At Streamstown, near Clifden, there is a quarry of very fine green marble; it lies in an opening in the side of a hill, amidst the most wild and romantic scenery. The marble can be shipped at Clifden. The only alternative is to cart it over fifty miles of road to the nearest railway station at Galway. Several projects for a railway between Clifden and Galway have been started from time to time, but hitherto without any practical result. Lissoughter green marble comes from a district of that name in Galway; it varies considerably in colour and texture. Some of it is comparatively soft, and contains a quantity of what is, more properly speaking, a green serpentine; much of it, however, is of a light colour and silicious.

Near the town of Galway there are extensive deposits of a grey fossil marble: it is very hard, and takes a good polish. A quantity of fine black marble is quarried in the neighbourhood of Angliham and Menlough along the verge of Lough Corrib and at Merlin Park. The quarry at Angliham produces some very large blocks. The limestone formation here is curious. At the top there is a layer, 3ft. in thickness, of loose weather-beaten stone; below this there is a deposit, 1ft. in thickness, of good, clean limestone; then a layer of loose chips, gravel, and clay; then a similar bed of limestone, also 1ft. in thickness. Below

this is a mass, 12ft. in thickness, of sound limestone which can be quarried in large pieces; then comes what is locally called the "blue bed"—a very hard, blue stone, which has streaks of white running through it, and polishes well. Below the "blue bed" comes what is called the "putty bed." This is a softer and finer grained stone than the last. Then comes the "metal bed," 4ft. in thickness, very hard, ringing like a bell when struck with the hammer. Below the "metal bed" there is a layer of flagstones 3in. to 5in. thick, both faces largely honeycombed, after which the first bed of marble proper is discovered. This is a layer 8in. to 11in. in thickness, and can be secured of any size which can be lifted. Then comes another layer of fine black marble, called the "London bed"; this is 11in. to 13in. thick. Immediately below it is the "double bed"; so called in consequence of a seam which runs through the centre of the bed. Each block has, therefore, the appearance of two blocks stuck together. The seam is almost 2in. in thickness, and is full of shell; but the remainder of the bed is as black as jet, and has very little white in it.

Foliated green serpentine occurs at Crohy Head, in Donegal, and a dense olive-green variety is found at Anghadorvey. A serpentine of a deep leek-green colour is also obtained in the county of Sligo.

About five miles from Waterford a grey fossil marble

is found at Ballykiloboy quarries; a handsome dark grey variety has been worked at Moate, in Meath county. At Killarney there is a striped red and white marble, and in some of the islands of the Kenmare river, near Dunkeroon, there are found marbles of various colours: black and white, purple, white and yellow, and some specimens of a purple colour veined with dark green.

In Donegal, the beds of limestone are found converted into white crystalline marble when in proximity to the granite; it is not, however, sufficiently pure or close in texture to be employed for statuary purposes.

Chapter IV.

BELGIAN MARBLES.

BELGIUM does not possess any great variety of marbles, but they have been most energetically worked. A considerable trade is done in manufactured marble goods, the principal market for which is found in England. Belgium imports large quantities of rough marble from France and Italy, much of which is manufactured, and being then re-exported from the Belgian ports passes current as "Belgian" marble. The industry and pertinacity of the Belgian people has been strongly exemplified by the manner in which they have developed their marble trade; they do not possess one-tenth part of the natural advantages of France in this respect; but they have, notwithstanding, made their country the principal European market for the cheapest class of coloured marbles.

The production of Belgian marbles is increasing at a rapid rate. In 1881 the quarries produced a total of 24,789 tons, valued at £55,868. In 1884 they produced a total of 36,264 tons, valued at £86,680.

Notwithstanding this great increase of home production, the trade with England has remained nearly stationary. In 1881 Belgium exported to England stone of all kinds, rough and hewn, 15,921 tons, valued at £93,335. In 1885 the quantity had very slightly increased to 16,071 tons, valued at £94,588. The bulk of the trade centres in the province of Namur. In 1884 this province supplied 70 per cent. of the total production, raising 25,369 tons from 59 quarries in active operation, and giving employment to 1,074 quarrymen. The men are miserably paid, the average daily wage being something under 2s.

Perhaps the best known—certainly the most useful—Belgian marble is St. Anne's. It bears the reputation of being the soundest of all coloured marbles. The first quarries which were ever worked in Belgium were opened during the last century at Solre St. Géry, close to a little chapel dedicated to Sainte Anne. The marble is of very dark grey ground, with patches somewhat lighter, and is regularly veined and flowered with white. There are several varieties. The most esteemed is of the darkest ground colour, and the veining is large and well defined. This is produced near Biesmes and Gougnies; these two villages are close together, not far from Charleroi. At the present time there are some half-dozen quarries in work at Gougnies and three at Biesmes. In this

district the marble is reached a few yards from the surface, and is of little value until a considerable depth has been reached—in fact, the deeper the quarry the better the marble. The beds are of peculiar formation; they appear to run along in a huge vein some 60-ft. wide, and of very great thickness. They commence at Biesmes, run through the village of Gougnies and end at Gerpinnes, a distance of about six miles. The deepest workings are at Gougnies where they attain a depth of 85 feet. On each side of the true marble there is a sort of bastard description, which is of no value. The quarries assume the appearance of so many very deep railway cuttings, which turn and twist to follow the direction of the vein.

At Gougnies there are several saw mills driven by steam. At Biesmes which is on the bank of the river Sambre, water power is brought into requisition. The mills are only a few yards from the quarries, and a large factory has been built for the manufacture of chimney pieces and table tops. St. Anne's marble is also quarried at La Bussière near Erquelinnes. These workings are much older than those of Gougnies. They are on the right bank of the Sambre and follow a direction east and west. The beds extend over a space of about three miles in length and from 30 to 120 feet in width. They are from 12 to 20 feet in thickness. The marble from this district is sound and of compact

texture; but the ground is of a lighter colour, and the beauty of the veining is not to be compared with the St. Anne's of Gougnies and Biesmes.

The annual production of the La Bussière quarries is estimated at 35,000 cubic feet, that of the Gougnies district at 53,000. There is a quarry of St. Anne's at Solre St. Géry, near Beaumont. This variety has a dark ground with grey markings, but it wants the white crystalline veins which are the chief beauty of the marble. It is principally exported to France. It is little esteemed, and is sold at a low price to the makers of cheap furniture.

The red marbles of Belgium are known by a number of fanciful names, which serve rather more to bewilder than to answer any useful purpose. Rouge Royal, Rouge Griotte, Rouge Byzantine, Rouge Fleuri, Malplaquet, and Rouge Rosé, are a few of the titles which the wit of the quarrymen and of merchants have found for a red marble, which has much the same colour and character whatever it is called. The best Rouge is of a good dark brownish-red ground, with the veining well marked and of a clear white; the least esteemed is of a light brown ground, blotched with patches of white and lead colour, and the veining is indistinct and irregular. The great bulk of Rouge marble will be found between these two extremes. It has come to be generally understood that to specify

"Rouge Griotte" is to mean Rouge of the best quality which can be obtained. Rouge marble is in general more or less unsound. There is plenty of room for the exercise of ingenuity on the part of the workman in the matter of stopping and doctoring clay cracks and other faulty places. In this work the Belgian is supreme: the average English artisan does not take to it so kindly. The principal quarries of Rouge marble are worked in a district which may be inclosed in a circle of some ten miles in radius, of which the town of Phillipeville is a centre. They are found at Sautour and Neuville, two villages about two miles south of Phillipeville; at Villers-le-Gambon, some three miles to the east of the same town; at Merlemont, Romedenne, and Vodelée. A species of Rouge is also found near Wellin, in Luxembourg; it is of a brownish-grey colour, and remarkably sound, but is very slightly veined, and is more suitable for columns, or for situations in which it can be used in large masses, than for general purposes of decoration. It can be obtained in very large sizes.

The black marble of Belgium is the finest to be obtained in any part of the world. No other country produces a marble which will compare with it in uniformity of colour and in fineness of grain. The best of it is a deep black, without mark or vein. It takes a magnificent polish, and is said to be easily

worked by those who are accustomed to it. The British mason tells another tale. There are four distinct grades known in commerce—best, second best, common, and inferior. These marbles are all found in beds of little thickness, perfectly stratified, and of the same general character.

The most important quarries are in the neighbourhood of Golzinnes, near La Bussiere. The deposits here extend for a length of about eight miles in a direction west and east from Villeret-sous-Saint-Martin-Balâtre as far as Rhisnes, through Falnue, Mazy, Golzinnes, and Isnes-Sauvages. The marble beds in this district are of a total thickness of from 30 to 40 feet, and comprise 25 to 30 layers, each from 4 inches to 2 feet thick. They are separated by other layers, called "bancs de croûtes." These are formed of a thin slate-like substance, which is of no value. The best marble is found in the lower layers, each of which is called by a special name according to its position or thickness. Thus we have the seven inch, the nine inch, the twelve inch, &c. The lay of the beds in the whole of this district is pretty regular, and everywhere there is found the same succession of layers of nearly the same thickness and of the same quality. In the neighbourhood of Isnes some of the layers appear to grow thicker, but this is due to the fact that several of them have been crushed together by their own weight and appear as one.

The method adopted for working the quarries is as follows:—The top soil having been removed, the upper layers are raised in the ordinary manner with wedge and lever, the workings being in the open. The beds are set at an angle of 16 to 20 degrees, and soon attain a great depth; it would entail too great a cost to work the lower beds in the same way as those nearer the surface, so these latter are got at by driving a series of tunnels through the worthless layers. By this means the best marble of the lower beds is obtained with a minimum of waste, and without disturbing the top rock.

The black marble obtained in the neighbourhood of Dinant is also of excellent quality, but the principal production is in blocks of small size, from four to five inches in thickness. Great quantities of this marble are sawn up into very thin slabs and used in the manufacture of clock cases. There is also a large trade done in the making of marble tiles for flooring. The introduction of special machinery for the making of these tiles has caused them to be produced at less than half the cost at which it was possible to procure them a few years ago. The black marble of Dinant has been long known and appreciated. There are the remains of several ancient quarries along the right bank of the Meuse to the south of the town. The present workings in this locality are at Furfooz, where

they are driven into the sides of the mountain, and at Denée. The former produces marble of the best quality.

Deposits of black marble are also found near the French frontier, in the Province of Hainaut, at Basècles, Quévaucamps and at Péruwelz. A number of quarries have been opened in this neighbourhood, the beds extending over a district some four miles in length and half a mile in width; the quality of the marble is not so good as that of Golzinnes or Dinant, the grain is not so fine nor is it such an intense black. When polished, it is frequently found to contain grey spots and thin white veins. The principal beds, specially worked at Basècles, are the four inch, the eight inch, and the twelve inch—of these the best quality is the four inch, but there is a great deal of waste attendant upon the use of it.

Belgian Grande Antique is produced at Roisin in the valley of Hogneau near the French frontier. It is not so finely marked as the true Grande Antique of France, but it is nevertheless a very handsome marble: the ground is black and the veining is white and crystalline. Quarries of this marble are also worked at Grand Marchin, not far from Huy. These last were only opened out in 1884, and the workings are, therefore, of comparatively recent date. As they get deeper the quality is likely to greatly improve; the marble is very sound, and can be obtained in large blocks up to 12-ft. in length.

Blue Belge is a marble with a dark bluish black ground cut up with fine white veins. It is a sound useful marble, but it is not beautiful: the veins generally run in nearly straight lines; this gives a monotonous sameness of effect when the surface is polished; it is, therefore, one of the least prized of Belgian marbles. It is cheap, and is much used in the making of the commoner description of chimney-pieces. The total annual production is about 14,000 cubic feet. It is found in stratified beds, which vary from 12 inches to 30 inches in thickness. The quarries are situated at Bioul, a small town on the road between Oret and Godine; at Bouffioulx near Châtelet; at Haut-le-Wastia; at Grand Marchin; and in the neighbourhood of Namur.

A variation of Blue Belge, in which the ground is very dark and the veining is something less formal, is called Bleu Limité; this is found near Wellin, nor far from the celebrated grotto of Ham-sur-Lesse. This district also produces two excellent fossil marbles known as Historique, and Belgian Fossil The former is a black marble marked all over with fossils and shells; the latter is of somewhat lighter ground, but of similar appearance, The quarries, from the slight inclination of the beds. are easily worked; the marble is cheap, and is much used in France and Germany, but does not seem to suit English taste, as very little has been imported here

Near La Bussière and on the banks of the Sambre river, the marble, known as Coquillier, is raised. It is highly fossiliferous, with a black ground and spots and markings of clear white; there are also quarries of Coquillier in the Hogneau valley near Roisin. The same district produces a marble called St. Amande. This is a dove-coloured stone with a reddish tint. The demand for it is very small and principally local.

Jaune Oriental is found in quarries near Bioul. The name is somewhat misleading—in colour it is not yellow—the prevailing tint being a reddish brown. The ground has a semi-transparent crystalline appearance, and the surface is broken up into small particles, coloured grey, red, and pink; it is a hard marble, fairly sound, and takes a very high polish.

On the Meuse, about six miles from Namur, is the town of Lustin, near which is found some marble called Florence. It is a fossiliferous marble of a grey tint, and little known or used outside Belgium; it is sound and takes a fairly good polish, but has little to recommend it on the score of beauty. This marble is also quarried at St. Gerard on the road between Dénée, and Fosse.

Brêche de Waulsort is a finely marked marble. As its name implies, it is a brecciated variety; the mass of it is composed of fragments of white, black, red and

pink, of many shades and closely intermingled. For a breccia it is remarkably sound, the numerous fragments of which it is composed being very firmly held together by the cementing matrix. The quarries are not far from Hastières, a village on the road between Vodelée and Dinant. It is largely used in the manufacture of clock cases and of chimney-pieces, and has always been in good demand. It is sometimes known as Brêche de Dourlais. A very fine example of it may be seen in some pillars in the Church of St. Roque.

The Belgian quarries are well managed in the matter of mechanical appliances. Many of them are of a very considerable depth, and the blocks of marble are brought to the surface up inclined tramways by the aid of steam power. In this respect the management of the Belgian quarries is in striking contrast to those of Italy. In the quarrying of St. Anne's marble, it is nothing unusual to see rough blocks of as much as thirty tons in weight detached from the solid rock and brought to the surface. These large masses are then cut into smaller and saleable blocks, and the saving of waste is enormous, as compared with a plan by which only comparatively small blocks are quarried. It is curious to see the sawing of these great blocks, which are sometimes as much as 8ft. or 9ft. in thickness ; they cannot be placed under a frame, and the first cuts are put in by hand. It takes four men to work the saw ; two of them work

from the ground, and two are placed above the others in chairs with very long legs, and thus all four get a grip together, and the saw is pulled through the cut. This is a slow process, and will soon be one of the past. A new saw has been invented which, for single cuts of this description, is unapproachable; it consists of an endless wire, to which a rapid running and rotary movement is given by means of revolving pulleys. Sand and water are applied as in the ordinary frame saw, and the work which is got through by this contrivance is said to be something marvellous.

A great advantage which the Belgian quarry-owner has against his competitors in other countries is the development of the Belgian railway system, and the consequent low cost of conveyance from quarry to saw-mill, factory, or seaport.

Belgium possesses several deposits of a kind of porphyritic granite. The principal quarries are at Lessines and Quenast; but it is also found at Barse near Huy, and at Wellin. The quarries at Lessines have been in constant work for more than a century; they are now over 150ft. in depth, and are producing most excellent material. Belgian granite is more like the English Purbeck marble than the true granites found in the United Kingdom. Unlike Purbeck, it can be obtained in very large blocks which is an advantage. It is extensively employed in Belgium

France, and Germany, in ordinary building operations. It is hard and very durable, but does not require the same amount of labour to be spent on it as is needed by the British granites. An enormous trade is done in Belgian granite paving, and the *débris* of the quarries finds a ready sale for macadamising purposes. Great quantities are sent to Brussels and to Paris, and considerable shipments are made to English ports. Belgian granite may be most usefully applied to situations in which a hard durable stone is required, and in which cost is an object. When finely axed, there is little difference in its appearance and in that of the grey granites of Scotland and of Cornwall. A good example of Belgian granite may be seen in Bristol, where it has been used in the construction of the new offices of the Capital and Counties Bank.

Chapter V.

FRENCH MARBLES.

THE marbles of France have been known and worked for many centuries. The Romans made extensive use of them. They are to be seen in ancient work at Lyons, Marseilles, and in Rome itself. In the 11th and 12th centuries they were largely employed in the building of French churches. During the reigns of Louis XII., Francis the Magnificent, and of Henry II., the quarrying of marble in France became a most important industry. From the State records we learn that in 1555 the making of the tomb of the late King Francis I. was intrusted to Ambroise Perret and Jacques Chanterel, marble masons, who agreed with Philbert de Lorme, Abbé of Ivry, and architect to the King, to saw and work the marble required, and find all saws, tools, tackling, and everything which was necessary for the due carrying out of the work, except the rough marble, which was to be delivered to them free from the King's store. A few years afterwards (in 1558) there appears a record of a payment of 200

livres to one Georges Baubertrand for the making of certain joinery, and a machine to saw marble and other stones, the invention of Philbert de Lorme, which he caused to be made to facilitate the execution of work, and to reduce the cost. It was in the reign of Francis I. that Jean Goujon flourished. He was the first great French sculptor, his most remarkable work being the Fontaine des Innocents, at Paris. The impetus which Francis I. gave to the development of the commerce in marble in his country was very considerable. We find him in 1536 writing to Jean de Bernuy, Councillor to the Parliament of Toulouse, especially recommending to his care the working of the quarries in the Pyrenees; and later he writes to the same person instructing him to send to Rambouillet several blocks which had been procured from the quarries near Toulouse, for the use of the sculptor Bachelier, one of the pupils of Michael Angelo. Nor was Henry II. much behind his father in this respect. Writing to his consuls at St. Gaudens, he describes the marbles of France as "the beautiful red, white, and green marbles of our country, which are as good in every respect as those which are brought at great cost from Genoa." In the time of Louis XIV. large depôts were established in Paris, in which marble was stored. The stocks accumulated by the king when building his palaces of Trianon, Marly Meudon, and Versailles are said to have been so large

that they served for the requirements of subsequent monarchs, until the Revolution made palaces for the great ones of the earth somewhat superfluous.

Since 1835, in which year a systematic effort was made to develop the French marble trade, it has prospered exceedingly. A considerable export business is done, principally with the neighbouring country of Belgium. The bulk of the trade is in the hands of established houses of high reputation, and in the possession of ample capital. No doubt this fact is owing to the enormous home demand, which was a consequence of the lavish expenditure of the Second Empire. During that period Paris was rebuilt. It is true that a severe depression has followed upon eighteen years of increased activity; but the trade has been so admirably developed all over the country that it now holds a position in relation to other trades which is unique.

France produces one white marble, which is regularly worked. It is called St. Béat, and is found near the town of that name on the banks of the Garonne. It will not compare with the statuary of Carrara, although patriotic Frenchmen have asserted that the statuary of St. Béat is second to none. It has been much used by modern French sculptors, notably MM. Carpeaux, David, and Pradier. It is, however, coarse in grain, and is more suitable for works of large proportion than for those in which delicacy of detail is a necessity.

The most celebrated work which has been executed out of the statuary of St. Béat is the magnificent "Ugolin" of M. Carpeaux. This group, which was illustrated in the *Building News* for March 26, 1886, was modelled by the sculptor in Rome, and was exhibited in plaster at the School of Art in Paris in the spring of 1862. M. Dervillé at once placed at the disposal of the sculptor, free of cost, a block of St. Béat, and the work was finished in the "national statuary" and exhibited at the Great Exhibition of 1867, when it received a medal of the first class. At the Exhibition held at Amsterdam in 1873, several French artists exhibited works in statuary of St. Béat, and there is no doubt that if carefully selected and skilfully chiselled, it takes high rank amongst white marbles.

The quarries of St. Béat produce, as well as the statuary, a greyish-white marble, which has been used in the construction of the exterior colonnade of the new baths at Luchon, the capitals and bases of the columns in the grand staircase of the opera-house at Paris, and for the pavements of some of the churches at Lourdes.

Some few miles west of St. Béat is the little village of Cierp, near which is found the rose-coloured marble called Rouge Acajou. It is a beautifully mottled marble, and can be obtained in very large blocks. It works easily, and takes a good polish. The beds of rock at the quarries present a very singular appearance.

Owing to a geological convulsion at some period of their history, they form a natural arch, and this disposition sometimes makes quarrying dangerous. A good example of Rouge Acajou is to be seen at the Hotel de Ville at Paris, where it has been used for some tablets put up in commemoration of the meeting of the first municipal council.

The celebrated quarries from which Sarrancolin marble is produced are situated high upon the hills near Ilhet and Berede, on the right and left banks of the river Neste, and in the middle of the charming Val d'Acère. Sarrancolin is a red marble with dove-colour markings. The quarries were first worked in the time of Louis XIV. by the Duc d'Antin, and great quantities of the marble were sent to Paris. In the king's depôt in 1699 there were stated to be 12 columns of Sarrancolin of 16-ft., and six columns of 15-ft., estimated to be worth 6 livres and 2 sous per foot cube. For many years the quarries were not worked, but they were re-opened in 1862, and are now in active operation. They supplied the marble which was used in the thirty great columns of the grand staircase at the Paris Opera House. These are in single lengths without joint, and each column cost £200 sterling. Sarrancolin has also been used on a large scale for the wall lining of the Tribunal of Commerce at the Magazins du Louvre, and at several other great buildings in Paris.

Some three miles from the quarries of Sarrancolin a black and white marble is found called D'Hechettes, from a village of that name close to the workings. D'Hechettes is something like the St. Anne's of Belgium. The ground is of greyish-black, and it is plentifully veined and flowered with white. It can be obtained in blocks of large size, and is very sound and free from flaws. Blocks of over 20-ft. in length have been obtained from these quarries.

The marble called Grand Antique is black and white. These tints occur in masses which are sharply opposed to each other. The result of this powerful contrast of colour is peculiar, but very pleasing under some conditions. The quarry is situate on the banks of the river Lez, near St. Girons and St. Lezier. At the foot of the workings the river cuts across a bed of the marble, which can be clearly seen below the water. Grand Antique is one of the marbles which were largely used by the ancient Romans. Fragments of ancient work in this marble can be seen in Rome, at St. Peter's, and St. Maria Maggiore. At the village of Aubert, where the quarry is situated, there are many traces of Roman occupation, and it is pretty certain that there was a village on the spot in ancient times, which was built for the convenience of the quarrymen. A number of antiquities have been found in the workings; these have been placed in the French museums. For many

years all traces of the quarry were lost. Writing in 1720, Daviller, in his "Art of the Builder," says: "There is a beautiful ancient marble, now very rare, as the quarries have been lost. It has a ground of pure white, and on it are large black patches. There are three columns composed of it in the chapel of Rostaing aux Feuillants, in the Rue St. Honoré." The quarry was re-discovered in 1844; but it was not until 1876 that it was vigorously worked. Since the latter date, Grand Antique has been largely used in France, and lately a considerable quantity of it has been introduced into this country. A very good example of the fine effect which may be produced by the employment of this marble is to be seen in the entrance hall of the Hotel Métropole.

Languedoc is found in the Montagne Noire between Carcassone and Lésignan. It is a bright red marble with large white veins. The formation of the beds show that the red limestone is the more ancient, and that the cracks in it were filled up with an infiltration of a nearly pure carbonate of lime which united the mass and formed the white veins. The quarries which produce Languedoc marble are so situated that the marble is easily worked, and large blocks can be obtained. Some fine columns of Languedoc can be seen at the Louvre, the Arc de Triomphe, and at the Palace of St. Cloud. In old times Languedoc was much prized in

Italy, where it was accorded a place of honour amongst French marbles, and was known as "Rouge de France." It is to be seen in the churches of St. Peter, at Rome; San Martino, at Naples; and in the Church of the Anunziata, at Genoa.

The beautiful French marble known as Griotte d'Italie is found in several parts of the Pyrenees, notably in the valley of the Barouse, in the valley of the Pique, and in the neighbourhood of Prades. It is, however, from the quarry of Bourriette, situated between Cannes and Felines, that the finest quality of this marble is obtained. The best Griotte d'Italie is of a dark red ground interlaced with deep brown veins, and with a number of small white shell-like spots scattered over the surface. It is much used in combination with black, for chimney-pieces and clock-cases, and in England is, perhaps, one of the best known of the French marbles.

Rouge Antique is found near Villerembert, and at Cierp. It is a dark red marble, with a curious resemblance to the ancient red Grecian marble; it divides with Rouge Griotte the preference of the clockmakers. The grain of the marble found at Villerembert is more beautiful, and the surface polishes better than the marble of Cierp; but the quarries only produce small blocks, so that it can be little used except for small articles. The balusters of the grand staircase of the Opera House at Paris are made of Rouge Antique.

Rosé marble is worked in the neignbourhood of Cannes. It is something in appearance like Griotte d'Italie, but is much less esteemed than the latter marble; it is, however, very sound, and has the merit of being cheap—two qualities which will always cause a demand for it. There are several other very fine coloured marbles found in the South of France. There is the Vert Moulins, also known as Griotte Vert and Griotte Campan. This is very similar to Griotte d'Italie, but intermixed with the black veins there are markings of a green colour, from which it derives its name. Vert Moulin is seen in the decorations of the Louvre and of the palace of Versailles. There is the Brêche Portor, which is a marble somet hing like the Black and Gold of Italy, but with the yellow veins of a much finer character. Luma Chelle; which is a greyish marble, with patches of light fawn colour and fine red veins; Noir Coquillé, a black marble with white veins; Bleu Turquin Coquillé, which is something like Italian Dove, but with more figure, and there are two marbles of very similiar character, known as Medousé and Grammont; these are both very handsome. They are brecciated marbles which have been formed under great pressure, and for this reason are more sound than is usual in the class to which they belong. The fragments of which they are composed are black, yellow, brown, and a beautiful crystalline white. Both these marbles polish well, and may be obtained in fairly large blocks.

Jaune St. Beaume is a handsome yellow marble, covered with a number of fine red and brown veins. The quarries are situated at Pourcieux, and at Trets, in the arrondissement of Brignolles; they have been worked for a very long time. In the year 1600, Henri IV. of France makes reference to them in a letter written to the Governor of Languedoc, and in the accounts of the Royal buildings in 1666, it is recorded that in that year the king bought from a certain Sieur Fromant some columns of 16-ft. in length of Sainte Beaume marble for 1900 livres, and some of 20-ft. length for 3000 livres. In these same accounts, which are curious, as throwing light on the value of marble in those days, we read that there was purchased of the Sieurs Chautermerle, Boileau and Cie, some columns of Griotte de Cannes and of Rouge of Languedoc, of large size, at 8 livres and 10 sous per cubic foot, and some of Sarrancolin at 6 livres and 2 sous. There also appears to have been purchased from the Sieurs Blancourt, Castille, Lebrun, and Cie, some columns of marble of Saint Béat at 15 livres the foot cube; this was in 1684.

Three very beautiful marbles are found in the neighbourhood of Molinges (Jura); these are known as Brocatelle Violette, Brocatelle Jaune, and Jaune Lamartine. The first named has been the longest known and worked. The quarry was opened in the latter part of

the last century; the ground is of a violet tint, and it is veined and marked with white and yellow. It is very compact and homogenous; in appearance it bears some resemblance to Spanish Brocatelle, but can hardly compare in beauty with the latter. Brocatelle Jaune is found close to the Brocatelle Violette. The difference between the two marbles is that the one has received a purplish tint from contact with oxide of iron, while the other has not been so coloured. Brocatelle Jaune has a yellow ground, and is marked with brown and white veins.

The pick of the marbles of Molinges is Jaune Lamartine. This marble is so-called from the fact that the property upon which the quarry is found was part of the estate of the Chateau de Pratz, which belonged to the family of the great poet Lamartine. The marble was named after him. It is of very fine colour and marking. The ground is a rich yellow, and it is profusely veined with fine pencillings of red and brown.

Rouge du Var, or Rouge Jaspé du Var, is found in the mountains of Var, in the south of France. The colouring and marking of this marble is not so good as that of the marbles of Molinges; but it has become popular of late, and a considerable quantity has been exported for English use. In colour the tints of red and yellow appear side by side with white in sharp

contrasts, and in irregular patches rather than in delicate veins upon a clear ground.

The marble known as Brêche St. Antonin is found near Aix. In colour it is a mixture of yellow, red and brown. For the most part the first-named predominates, but the marking is very unequal. Like all the marbles to which the term " Brêche " is applied, it appears like a mass of variously-coloured pebbles which have been cemented together. Brêche St. Antonin is fine in grain, and takes a very good polish, but it is not sound, and is worked with much difficulty. It is sometimes called Brêche d'Aleps and Brêche Imperiale. Several columns at the Louvre and at the new opera house in Paris are composed of it. It was also used in the decorations of the staircase at the School of Beaux Arts and at the Madeleine.

Vert Maurin is found near the hamlet of Maurin, in the canton of St. Paul, near the Italian frontier. The quarry is high up in the Alps, and can only be worked in the months between June and September; all the rest of the year it is inaccessible. In appearance this marble very much resembles Genoa Green. It is of a dark green ground veined all over with white; it is not quite so rich a colour as the Italian marble, but it works more easily, and blocks can be obtained of large dimensions, transport being the chief difficulty.

A marble much used in northern France is the

Rose-Eujugeraie. The quarries are at Bonëro, near Mayenne. They were first opened and worked for limestone about the year 1820, but it was not until some years afterwards that the discovery was made that some of the beds produced marble of fine quality. Rose Eujugeraie is sometimes called "the Sarrancolin of the west," and in its vivid colours it does frequently resemble the Sarrancolin of the Pyrenees. The ground is red, interspersed with patches of a pearly grey, and with bright red and white veins. It is a very compact marble. The blocks are obtained with few defects and of large sizes. It is fairly easy to work, and takes a high polish, and is the best known of the marbles of western France.

A black marble, and one of black veined with white, are raised in the neighbourhood of Laval. The workings are, however, of small importance, the marble being used for the most part locally.

Near Caen, in Calvados, a madrepore marble called Caen marble is obtained. It is of a dark brownish-red colour, with large grey and white veins. The production is on a small scale, but some years ago it was much used in Paris for the tops of coffee house tables.

A grey and white marble called marble of Angiers is found near the town of that name. It is fairly sound, but does not take a high polish, and is now in

little demand. Of the minor French marbles may also be mentioned those of St. Etienne, where several varieties are found having a yellow ground heavily marked with white veins.

Close to the Belgian frontier, near Jeumont, is found the Black Vein of Marpent. As its name implies, this is a marble with a deep black ground, finely marked with white veins. This marble is sound and homogeneous in texture, and takes a good polish. It can be obtained of large dimensions, and is in great demand, more especially for the home market. The quarries are on the banks of the river Sambre, and were discovered by the celebrated engineer Vauban in the 17th century. They supplied him with the stone with which he built the fortifications of Maubege, and they have been worked for marble ever since that time. There are several large works in the neighbourhood of the quarries and along the banks of the Sambre, for the sawing and working of marble; in fact, this district is one of the centres of the trade, more especially since France established protective duties against the importation of sawn or worked marble. The Belgian marbles required for consumption in France are brought over the frontier as rough blocks, and the river Sambre is the natural highway by which much of this traffic is conducted. It also supplies the mills with the necessary water power. At the present time the

French Government allows marble blocks to be imported free, but charges on sawn slabs 8s. per ton, on polished marble 12s., and on small articles, such as clocks, vases, and the like, 32s. per ton of 1,000 kilos.

Near the ancient town of Bavay, in the valley of Hogneau, there are some large quarries of black marble. French black, as it is called, is not to be compared for purity of colour with Belgian black. The grain is not so fine, and it is difficult to obtain a sample free from spot or mark. The geological formation of the beds renders the work of quarrymen easy ; they are inclined at a considerable angle, and are of some thickness. On account of the extremely low price at which this marble can be produced, it enters very largely into building works in France, more especially in Paris, to which place considerable quantities are annually sent.

Another low priced marble, and one which is most useful in certain situations is Comblanchien. This marble is of a light cream colour, and is obtained in blocks of fairly even colour, without distinct marks or veins. It is of compact texture and hard, and is much used for steps and staircases, for which purpose it is admirably suited.

Close to some quarries of French black at Hou-Hergies, a bed of marble, about 45ft. in thickness, has been discovered. It is of a bluish-grey ground, veined and patched with white, and very much resembles the

St. Anne's of Belgium. It has been named French St. Anne's, and has found plentiful employment in the manufacture of the cheaper kinds of mantelpieces. The quarries are being energetically worked, and the production has rapidly increased in recent years.

In the Vallée Heureuse, near Boulogne, there are some very large quarries, from which are extracted the marbles known as Lunel, Lunel Fleuri, Joinville, and Napoléon. Of these the first-named is of a dull brown colour, with very little marking. It harmonises remarkable well with red brick, and is much used for large columns and work of a similar character. The great size of which the blocks can be obtained renders it especially useful for this class of work. Columns up to 12ft. in length in one piece can be readily obtained. Lunel Fleuri has the ground colour of Lunel, but the surface is marked or flowered all over with markings of a darker colour. Joinville differs from Lunel in that it is slightly marked with red patches and veinings. The best of the Boulogne marble is the Napoléon. This stone has a ground of a light fawn colour, and is beautifully marked with pink and brown veins, which are delicately interlaced all over the surface. The working face of the quarry is about half a mile wide; it is worked for building stone as well as marble. The present daily extraction amounts to upwards of 1,000 tons in all. Much of

the marble has been exported to Belgium and to Germany, but it has only lately been introduced into England. It appears to be suitable for employment in large masses where a marble is needed free from decided colour or markings.

Chapter VI.

SPANISH AND PORTUGUESE MARBLES.

SPAIN and Portugal possess several deposits of white and coloured marbles; but owing to difficulties in the matter of land carriage, and to lack of enterprise, they are difficult to obtain, and many of them are little known beyond the immediate neighbourhood of the places in which they are worked.

At the Paris Exhibition of 1867 there was exhibited a large collection of Portuguese marbles, and it appeared likely that the sale of them would be pushed. The effort was spasmodic, and never followed up, and to-day, with the exception of one or two varieties, the marbles of Spain and Portugal have yet to find a place in the commercial world.

Of Portuguese marbles the best known is Emperor's Red: it is of a pale red, shaded with veining of dark red and brown. A fine block of this marble was presented by the late Don Pedro, King of Portugal, to Queen Victoria, for the Royal Mausoleum at Frogmore.

Within the last few years quarries of one of the most beautiful marbles discovered in modern times have been

opened near the town of Villa Nova d'Ourem. It is called St. Silvester; the prevailing colours are pink and white, the pink of a most exquisite tint, and the white of semi-transparent appearance. St. Silvester will take a high place amongst the most prized of our ornamental stones. It is fairly sound, takes a very high polish, and is not difficult to work; it has been lately introduced into this country, where it has met with marked favour. It has been employed for decorative purposes in the building of the Eastbourne Town Hall, and in works at Manchester, Liverpool, London, and Bristol; it requires to be better known, when there is no doubt the trade in it will be enormously developed.

A marble known as Iberian Agate is found in the same district as St. Silvester. It is not so beautiful as the last-named, but for columns and work of similar description it is very useful and effective; in colour it is a curious mixture of dark red, yellow, and slate colour, and of every variety of tint caused by the mingling of these colours. It is of hard, compact texture, and takes a good polish.

From the quarries of Montes Claros in the Alemtejo there are several varieties of marble raised, most of them belonging to the class known in Italy as "Bardiglio." There is no doubt that some of these are of great value. The splendid monolithic columns

of the cathedral at Evora and of the Royal Chapel at Villa Viçosa were obtained from the quarries of Montes Claros. This district also produces a highly-crystalline white marble of a slightly roseate tint, and a dark red marble. Close to the village of Borba a marble is found called Rose Venus; it is of a flesh tint, with greenish spots and yellow veins. At Estremoz there is a quarry of a coarse crystalline white marble.

The "Lios" and "Vidraco" marbles are fossil limestones, found in the quarries of Pero Pinheiro and Lameiras, between Lisbon and Cintra. This district produces three marbles of different shades of rose colour, and the blue marble of Cintra. This last is highly crystalline, and takes a good polish. It is of greyish ground, spotted and veined with blue and black.

At Oeiras, near Belem, there is found a brocatelle marble, with large spots of brown and red.

The modern trade in Spanish marbles is even less than in Portuguese. That it is of such small consequence is due to the same causes which prevent the development of the trade in Portugal. There is abundance of the raw material; but very little of it sees the day. In former times the marble quarries in Spain were largely worked. We have proof of this fact in the remains of the works of the middle ages. The vault of the beautiful theatre of Toledo is supported

by 350 marble columns, and the mosque of Cordova, erected by Caliph Abdoulrahman III., is ornamented with 1,200 columns, most of which are of Spanish marble.

Among the ruins of ancient Merida, which was built 28 years B.C., fragments of valuable marbles of native origin have been discovered. The Church of the Escurial and the palace itself are decorated with some of the most beautiful marbles, and the same may be said of the principal churches of Madrid.

Near Almeria, in Grenada, there is a mountain of white marble of somewhat coarse grain, which, however, takes a good polish. The rocks which surround the town of Molina, in New Castile, are composed of a white marble, which has been employed in the palace of the Alhambra at Grenada. A white marble is also found at Badajoz, and one with large grey spots at La Mancha, in New Castile. A greyish marble is found at Toledo, and one grey with white veins and spots at Elvira.

At La Mancha there is also found a black marble which is of a very deep colour, and takes a good polish. Another black marble is found near Segovia.

In Valencia there are quarries of a dull red marble, with black veins. This is worked and used locally for table tops and similar uses. Near Molina there is an entire hill of a red, yellow, and white marble, which has a coarse, granular texture, like sugar.

The mountains of Guipuzcoa produce a red marble veined with grey, which closely resembles that of Sarancolin. Near Fortosa there is a deposit of a violet-hued marble, spotted with bright yellow. A similar marble, but of a duller colour, with orange-yellow spots, is found near Valencia.

At Rielo, in Arragon, there is a quarry of a fine breccia marble. It consists of angular fragments of a black marble imbedded in a reddish-yellow base. At Old Castile there is found another breccia, which is of a pale yellow, brick red, deep brown, and blackish grey. This marble was once exported to Paris and other parts of the Continent in considerable quantities. Spanish brocatelle had also at one time a high reputation. In colour it is of a deep red, variegated with numerous spots and points of light yellow, yellowish grey, and a translucent white. The greyish spots in this marble, when closely examined, prove to be fragments of shells. This marble has a particularly bright appearance, but it is now little used.

Chapter VII.

GRECIAN MARBLES.

THE statuary marble found in the island of Paros and at Mount Pentelicus was held in high estimation in ancient times. This marble is composed of nearly pure carbonate of lime of a coarse crystalline granular texture. It has larger crystals than the statuary of Carrara, and when fractured it presents a glittering play of light from the crystalline facets, of greater brightness than that from a like surface of Carrara stone. This distinction can be easily detected, and is one means by which we are enabled to determine the origin of a fragment of Greek or Italian statuary.

The Parthenon at Athens was built of Pentelic marble. There are now standing at the entrance to the building six whole columns with gateways between them. Each of the columns consists of three or four stones, but they were so carefully put together that no separation has been observed, although they have been exposed to the weather for more than 2,000 years.

The celebrated tomb of Mausolus, from which we get our word "mausoleum," was built of Parian marble,

part of which was coloured, some red and some blue. This was one of the most wonderful works in marble which the world has seen produced. It was designed by the architect Satyros and the sculptor Pythios. The latter and four other celebrated sculptors were employed upon it. The artists are said to have finished the work "for their own honour and the glory of art." Whether they were content with honour and glory alone history does not say. Part of the remains of this famous tomb are now in the British Museum, having been secured to the nation by the indefatigable exertions of Mr. C. T. Newton. One of the finest specimens of the sculpture—the head of a lion, treated in the best style of art—was purchased by Mr. Newton for a dollar! These priceless works have lately been mounted on plinths of the beautiful Numidian marbles. Nothing like the tomb of Mausolus has ever been built since, even in these days of millionaires and big things. The entire tomb was raised on a platform, which formed a parallelogram 469ft. on the outside. It comprised a small chamber in the basement, in which the remains of Mausolus were placed; a temple upwards of 50ft. high, in which the admirers of the dead man might assemble to pay homage to his memory; a colonnade above this, consisting of thirty-six graceful Ionic columns, 37ft. high; a pyramid of steps, and a pedestal with a base, 108ft. long and 86ft. wide,

resting upon these columns; and at the top of all a colossal group representing Mausolus being carried to heaven by his favourite goddess in a chariot drawn by four horses abreast. At the corners of the basement and level with the ground, there were colossal groups of sculpture, and above between the columns were placed figures of deities and heroes. Well might Anaxagoras exclaim, when he saw this costly memorial to the dead, "How much money is here turned into stone!"

Many of the architectural works in ancient Rome were built of Grecian marble. Examples may be seen to-day in the three Corinthian columns, with their entablatures, which belonged to the temple of Castor and Pollux, and which now stand in solitary grandeur amidst the ruins of the Roman Forum.

Parian and Pentelic marbles were principally employed by the ancient sculptors for their work. The group known as the "Farnese Bull" is of Grecian marble. This group consists of seven distinct figures, including the bull and the dog. It is now in the Museum at Naples. The entire group was originally cut out of a single block, which must have been of enormous proportions. It is the work of the Rhodian sculptors—Appolonius and Tauriscus. The original group of the Laocöon in the Vatican Gallery at Rome is also worked out of this marble. A curious tale is

told of the sculptor Pacetti and the trouble which he experienced in the restoration of an ancient figure which had been sculptured out of Pentelic marble. He purchased the fragments—a figure of beautiful proportions, but wanting arms and legs — from the Barberini family for a small sum, and took it to his studio, where he made a complete model of the missing portions, and produced the sleeping figure known to art as the "Barberini Faun." When he tried to procure the marble to carry out his work he could nowhere obtain a stone the grain of which would match his fragment; he at last purchased another Grecian sculpture of inferior merit, and destroyed it in order to obtain material with which to complete his restoration. This plan proved to be entirely successful; but when the sculptor imagined he would reap the fruit of his labours, he was cruelly disappointed by the action of the Papal Government, which then held sway in Rome. He sold the restored figure for a considerable sum of money to a German prince; but the sale was forbidden by the Government, who ordered troops to enter his studio by force and remove the work. This arbitrary act was carried out, and the sculptor was offered, as sufficient compensation, the return of the 700 or 800 scudi which he had originally paid for the fragment sold by the Barberini. Pacetti so deeply felt this cruel treatment that he took to his bed and died, and

it was not until years afterwards that his executors were at last able to come to some terms with a Government which thus rewarded the ingenuity and skill of its subjects. If Pacetti had lived in these days he would not have found so much difficulty in procuring Grecian statuary. The Pentelic quarries have recently been re-opened for the restoration of some of the buildings in Athens, and attempts have been made to once more bring the marble into general use. The statuary of Greece will not, however, compare with that of Italy for ordinary purposes. It is indeed probable that the discovery of the one led to the disuse of the other. Both Parian and Pentelic are extremely hard, and the large irregular crystals contained in them make them very impracticable and difficult to work. They emit sparks when being roughed down with a point chisel, and the tools used are quickly blunted and broken. Pentelic is particularly difficult to work, and the action of the weather on the surface eats away the softer layers, and leaves the harder parts standing. This is shown by the appearance of some of the fragments of Grecian art in the British Museum. The modern sculptors, Gibson and Kopf, have used Grecian statuary, but chiefly by way of experiment, and there is little probability of the marble again coming into general use. The glory of Grecian marble is of the past. It is said to possess one

advantage over the Italian statuary — with age it acquires a beautiful warm tint. This is, however, dearly purchased by the great difficulty which is found in working it.

Chapter VIII.

OTHER EUROPEAN MARBLES.

SEVERAL marbles are raised in Austria, but for the most part they are used only locally. Bleyburg marble is raised near the town of Bleyburg, in Carinthia. It is sometimes called "Opalescent Lumachelle," from the shining appearance which is produced by the shells of a species of nautilus; these appear imbedded in the mass. The colour of the marble is a brownish-grey, shaded with a darker tint. It is full of the fragments of shells, which reflect red, green, and blue, with striking effect. One great drawback to the use of this marble is that it can only be obtained in small pieces.

Carniolo marble is found in several parts of the province of that name; in colour it is flesh-red, veined and shaded with white. In the same province there are quarries of a breccia marble, with a matrix of pale red, and fragments of grey, white, and blue.

Some very beautiful porphyries and serpentines are quarried in the Tyrol, near Sterzing, and also at Laas. The porphyries are black and red, very hard and solid, and take a high polish. The serpentines are red and green: they are of compact texture, and polish well.

All these stones will bear exposure, they are much used for columns and inside work. A large establishment has been built at Sterzing, where the stone is worked. The principal market is at Vienna, but export is made to France, Germany, and Italy. Near Laas there is raised a white statuary marble, a sample of which was exhibited at the Exhibition at Antwerp in 1885. It is very pure, but the texture is inferior to the statuary of Carrara. The total annual production of the Tyrolese quarries is about 12,000 cubic feet.

The best known of the Austrian marbles is that raised in Istria, not far from Trieste. Istrian marble is of a light cream colour, is of very compact texture, and an excellent weather stone. It was largely used in the construction of the palace of the Doge, the Church of St. Mark, and of numerous other buildings in Venice. Philipe de Commynes, writing of his entry into Venice in 1495, mentions the effect produced upon him by the sight of Venetian architecture, and makes note of the fact that the palaces built within the last century had all their fronts of white marble brought from Istria, 100 miles away. In more modern times little has been heard of Istrian marble; lately, however, it was selected as the material out of which the sculpture of the panels in St. George's Hall, Liverpool, should be carved, and it has been employed for the purpose by Mr. Stirling Lee. It is calculated to with-

stand the action of sulphuretted hydrogen to which this work will be exposed.

Very little marble has been raised in Switzerland. The principal quarries are at Roche, near Aigle. Here a marble is raised which is very much akin to the Belgian Rouge Griotte; it is a red marble, with white veins and dark brown patches.

On the banks of the river Llahn, near the town of Nassau, in Germany, there are large deposits of marble. These are worked at the quarry at Arfurt, which produces a dark grey marble; at Seelbach quarry, where a pink and white marble is raised; at Gondenbach, where the marble is of a deep black with white veins, and is in great demand locally; at Meiklberg, where a light and dark grey marble is produced; at Marichette and Kissel, which produce a light red marble; at Castell, where the marble is of a red ground with white markings; at Borngrund, where a marble is quarried of light red colour with light grey veining, and which is now being used in the construction of the new palace at Strasbourg, for the Emperor of Germany; at the quarries of Famosa, where the marble is of a greyish-red with yellow marking; at Bongara, where a red marble veined with white and marked with black is raised; at Gretenstein quarry, which produces a marble marked with red and viclet; and at Langenanbach, where there is a beautifully coloured marble of a brownish-red

ground marked with red and yellow. In the same neighbourhood there are several quarries which have been only lately opened up. One of them produces a red marble, known as Emmastein. It is much like the Rouge of Belgium. From another quarry is raised a dark marble with light veins, a grey, and a yellow variety. The last is a very beautiful marble. It is of yellow ground, with veins of purple and white, and a slight sprinkling of red. This quarry has only been placed in good working condition as lately as the month of March in 1887, and the marble has not yet made its appearance in the English market. It is said to be sound, and to take a good polish. It has been named Jaune Victoria.

Some large works have been established near Nassau, for the purpose of working these marbles, and saw-mills have been erected on the banks of the Llahn river. These works appear to be favourably placed in the matter of carriage to the seaboard. The Llahn runs into the Rhine near Coblenz, and from thence the voyage to Rotterdam is easy.

Near Hof, in Bavaria, there are several quarries of excellent marble. One of these yields marble of a fine black; another a curious deep-brown variety with red spots. There is also found a marble with a pale sea-green ground, veined with darker green and white. Baireuth marble is found near the town of the same

name. It is a red marble, with dark-brown markings. Quarries near Blankenburg produce a black marble veined with white, and a rich red marble of great diversity of colour. It is of a dark-red ground, variegated with markings of white, brown, and green. There is also found in the neighbourhood a very fine madrepore marble, in which a dark-brown ground is spotted with grey, black, and red.

Sweden produces a black and white marble, quarried at Jemtland, and a crystalline white marble, found near Tagernach. At Uddevalla there are extensive workings of the beautiful stone known as Swedish or green granite. During the last few years extensive consignments have found their way to the English market, and the trade is likely to prove a large one. It is a little more expensive than the ordinary red and grey granite; but its beautiful dark-green colour is peculiar to itself, and is shared by no other ornamental stone at present known. A microscopical examination of Swedish granite shows that it is composed of felspar, labradorite, tourmaline, garnet, apatite, and magnetite. It has been extensively employed in Sweden for monumental and architectural purposes.

Quarries of white marble have been opened and worked near the southern extremity of the Vel Fiord, at Hegge, in Norway, about 130 miles to the north of the town and harbour of Trondhjem. The depost

extends for a length of about three-quarters of a mile. A mountain torrent intersects the bed, and it was in consequence of the cutting of a channel by the stream that the marble was discovered. It is a pure white statuary, and some little time ago a consignment found its way into the London market. It was used for purposes of decoration at the International Health Exhibition in 1884, but does not seem to have met with general favour. In texture it is too coarse for ordinary statuary purposes; it is highly crystalline, the crystals are large, and the material difficult to work and polish. Whether the deeper beds will be of better quality remains to be proved. As far as regards purity of colour, the Hegge statuary leaves nothing to be desired.

The vast extent of the Russian territory, and the difficulty of transport, is much against any increase in the production of the marbles to be found in the country, and the requirements of Russian architects are almost entirely filled from foreign sources. The Ural Mountains contain stores of the most beautiful variegated marbles. The difficulties of transport are, however, so great that it is not probable they will ever be worked to advantage. The Empress, Catherine II., developed quarries in the neighbourhood of Katerinburg, and caused considerable quantities to be conveyed to St. Petersburg. The Orlof Palace is lined within and

without with Katerinburg marble. A great quantity of it was also used in the construction of the church of St. Isaac, near the statue of St. Peter the Great.

The Ural Mountains also produce the largest masses of malachite which have been anywhere discovered. Malachite is a carbonate of copper, and is not therefore a marble; but it has been so much used for purposes of decoration in the place of marble that mention of it should not be omitted. Malachite, when worked and polished, is very beautiful. It is of various shades of green, from a pale sea tint to a deep emerald. These shades are disposed in layers or bands around a central nucleus. Malachite has been extensively used in the decoration of the royal palaces in Russia and Germany. One of the most beautiful specimens of this material is in the Pitti Palace at Florence. It is in the form of a table some 6ft. in length, and is without a flaw.

A greyish marble is procured from some of the Onega Islands, and another of the same ground, but with greyish spots, is found on the banks of the Onega river. A light-green marble is found at Kiatcha, and another with light-green ground and darker spots is found at Jansa, an island in Lake Ladoga. At Kexholm, an excellent black marble is quarried. In the district of Olentz there are several quarries; one produces a dark-red marble, another a marble with black ground and brown veins, and another a breccia marble.

Chapter IX.

ALGERIAN AND TUNISIAN MARBLES.

VERY valuable quarries of marble have been found in the French colonies of Algiers and Tunis. It was from these that the Romans procured their so-called Numidian marbles. Numidia proper is outside of the district in which the greater part of the marbles are found; but it gave its name apparently to all of them. Pliny says that Numidia produced nothing remarkable except marble and wild beasts, and that Numidian marble was first brought to Rome under the consulate of M. Lepidus (B.C. 77), who used it in his own house. These marbles were greatly prized by the Romans, who imported great quantities of them; but after the fall of the Empire, they were altogether lost sight of, and have only lately been re-discovered and worked.

Some of these marbles are found in a district about twenty miles north-east of Oran, in the western part of Algeria. Near the little village of Kleber rises an imposing mountain called by the colonists "Montagne Grise" from its arid, grey appearance. This mountain

is one of a chain which stretches in a north-easterly direction from Cape Aiguille on the west to Cape Carbon on the east, and it is about the centre of the range. On its summit there is a level plateau with a superficies of some 1,500 to 2,000 acres, and running east and west. It is here that the marble is found. At the extreme east a creamy-white marble is produced called "Marmor bianco"; next comes marble of a beautiful flesh-coloured tint—"Rosa carnagione"; then a fine variety of "Cippolino"; and some yellow marbles of various tints—"Giallo avorio," "Giallo canarino," "Giallo paonazzo," and "Giallo antico." At the extreme west there are a number of breccias—"Breccia sanguina," "Breccia coronata," "Breccia dorata," "Breccia grande"—a deep-red marble, somewhat brecciated, and greatly resembling, if not identical with, the famous "Rosso antico," and a fine black and white marble, "Bianco e nero antico." There are numerous depressions to be seen in the "Montagne Grise," each evidently marking the site of a Roman quarry. Some blocks of stone have been found actually extracted, and some with grooves and wedge holes ready to be raised; but what is somewhat strange, there is no indication of any great monoliths having been prepared, and there is none of the usual *débris* of a quarry. Colonel Playfair is of opinion that the Emperors carefully guarded the secret of these quarries,

and that only comparatively small pieces of the precious stone were taken away just as they were separated from the mountain, without even any preliminary hammer dressing. They were probably worked up into mosaics, or used for other fine decorative purposes. Seneca mentions their employment in conjunction with those of Alexandria.

The re-discovery of these beautiful marbles was brought about by the finding of some very fine mosaics in some excavations made at St. Leu, in the vicinity of Arzen, the ancient Portus Magnus. These were recognised as being very like some of the long-lost antique marbles found in Rome, and led to a careful examination of the surrounding country, and the discovery of the treasures on the "Montagne Grise." Some of the first geologists in the country had carefully examined the mountain on account of the iron ore which it contains; they decided that it was not in sufficient quantities to make the working of it profitable; but they had failed to appreciate that it had already performed its task by communicating an almost endless variety of tints to the marble rock.

Algerian Onyx marble is found at Ain Tekbalet, near Tlemçen. It is translucent, faintly white, and iridescent, and of stalagmite formation, bearing a resemblance to Onyx—whence it derives its name. Bands of crystalline white alternate with others of

a yellowish-brown, dark brown, or umber colour. In ancient times, these quarries supplied the inhabitants of Rome and Carthage with the marble, which was much used for monuments, and for the internal decoration of houses. It was often cut into small vases for holding precious ointments, and was one of the stones known as Oriental alabaster. It is not an alabaster as we now understand the word; it is a true marble or carbonate of lime. It was very largely used in the beautiful Moorish architecture of Tlemçen, where Numidian marble is never found. Evidently, with quarries of Onyx at their doors, neither the Romans of Pomaria, nor their successors, the Moors of Tlemçen, were tempted to transport any other variety for the decoration of that important city, so many miles from the sea. Great quantities of Algerian Onyx have of late found their way to Paris, where it is extensively employed. With white, or any of the red or pink marbles, it forms a splendid combination.

The marble known as Rouge Etrusque is quarried near Chenouah. The quarries were opened out in 1874, and the marble was exhibited at the Paris Exhibition in 1878. It is a red jasper-like stone of singular beauty; it can be obtained in large sizes, and was employed for the construction of the large monolithic columns in the new vestibule of the National Gallery.

The marble quarries of Tunis are of very ancient

origin. It is certain that they were known to the Romans, as great quantities of the marble have been found in old Roman buildings. The knowledge of the source from whence the marble was obtained was lost for many centuries. The re-discovery of the quarries is due to a Belgian engineer, who was employed in constructing the railway between Algeria and Tunis. At Chemtou, in the Valley of the Medjerda, he noticed that part of a mountain appeared to have been cut away by human hands. Further investigation proved that this was the site of the old Roman workings, and the quarries were re-opened and are now being worked by a Belgian Company, whose headquarters are at Liége. The Chemtou quarries produce several red and yellow marbles, one of which is a breccia with a violet ground, and markings of great beauty, but the most prized product is the celebrated Giallo Antico, which is identical with that found in Rome. An excellent specimen of this marble may be seen in the wall panelling of the new staircase in the National Gallery. The marble is yellow, with a beautiful reddish cast. The texture is very close, and the marble works easily and takes a high polish.

The quarries are favourably situated in the matter of transport. The marble can be placed on rail at Oued-Meliz, from thence it can be conveyed for shipment to Tunis or to Bona. In ancient times the

marble was shipped from Tabarca. A road was constructed by Hadrian, on his first visit to Africa in 128—129 between the quarries and the port, for the purpose of transporting the marble to the sea-coast, and thence to Rome. During the time of the Antonines, most of the marble quarries known to the Romans had become the property of the Emperors either by way of confiscation, heritage, or purchase.

Chapter X.

EASTERN AND COLONIAL MARBLES.

THE marbles and granites of Egypt were held in much repute in ancient days. They are very little worked now, and most of the marble used in the country is imported from Italy. The celebrated Breccia di Verde is found between the Red Sea and the Nile, a little to the north of the caravan route to Mecca. It is a most beautiful stone. The matrix is of various shades of green, deepening into a purplish red, and containing pebbles of black, grey, green and white. Great quantities of this marble were formerly exported, and the churches of Italy and the mosques of Constantinople contain numerous examples of it.

Near Assouan there are immense deposits of red granite, which furnished much of the material used by the ancient Egyptians in the making of obelisks and other monuments, which have since found resting-places in various parts of the civilised world. The great obelisk of Luxor is now in the Place de la Concorde at Paris. Its height in the socket is rather more than 72ft. Another of these monuments, known as Cleopatra's Needle, is a familiar object on the Thames Embankment

in London. There are several in Rome, and one in New York. The enormous size of some of these monuments, cut out of a single stone, has made them the wonder of all ages, more especially when the mechanical means at the disposal of the engineers of that era have been considered. An obelisk, still lying in an unfinished state in the quarry of Syene, shows us how these great monoliths were quarried. The obelisk was cut out in the solid rock, and polished on three sides before the fourth was disengaged, wooden wedges were then driven in the under side of the stone, and these were repeatedly moistened until they swelled sufficiently to effect a separation from the bed below. From inscriptions and diagrams carved on some of the pedestals, we gather that the mode of transport to Lower Egypt was by the Nile, the stones being loaded on rafts. They were then dragged to the place where they were to be erected on a rude kind of carriage made of logs, which was set in motion by large trains of men and animals, and they were finally lifted on the pedestals by means of an inclined plane. The lasting properties of Egyptian granite is proved by the sharpness of the sculpturing on the obelisks. This in some cases was cut as much as 3,000 years ago. It is, however, a curious fact, that the same stones when set up in London and New York have shown signs of decay within a very few years of their erection in these cities.

Some ancient workings from which a great quantity of Egyptian porphyry was once obtained are on the Jebel Dokham—a mountain situated about twenty-five miles inland from the junction of the Red Sea with the Gulf of Suez. This stone is usually of a reddish purple ground, with small crystals of white felspar. It is the "Porfido rosso antico" of the Italian antiquaries, but must not be confounded with the "rosso antico" which was a true marble. Egyptian porphyry has a long history. It was worked by the ancient Egyptians, and was afterwards largely used by the Roman sculptors. It is very hard and difficult to work and polish. There is a large circular slab of it set in the pavement of St. Peter's at Rome, and upon it the Emperors were formerly crowned. In the same church there is a cover of a sarcophagus taken from the mausoleum of Hadrian, which has been converted into a font. It is fashioned out of a huge block of Egyptian porphyry, some 12 feet in width at its longest diameter. In the museum at Naples there is an example of the use of this stone which shows considerable ingenuity on the part of the sculptor. This is a colossal statue of Apollo. The God is seated crowned with laurel, wearing a tunic and holding a lyre and a bow. The head, the hands, and the feet are of white Carrara marble, but the robe is of Egyptian porphyry.

The native marble-workers in India have long shown

a considerable amount of ingenuity and skill in the working of the ornamental stones found in their country. Decorative art as applied to architecture is nowhere more remarkably displayed than in the ancient cities of the land of the Rajas of Rajputana, and of this district the city of Jeypore is in this, as in all matters of art, the centre of activity. There is a local school of art which has done great service in this direction, and has improved the high standard previously attained by the native workmen, and the Jeypore carvers of to-day bid fair to eclipse the reputation of those of former times, who were sent for from far distant states when the rulers were intent on the building of palaces or temples.

The celebrated Makrana marble is found in some quarries near Jodhpur, Rajputana. It is a white crystalline marble. A fine specimen of it was exhibited at the Indian and Colonial Exhibition of 1886. The front of the Ulwar screen consisted of panels of Makrana marble, which were perforated and carved in relief. These were supported upon pillars of the same marble, each 8ft. in height, and beautifully carved. Makrana marble was extensively used in the building of the great Mogul monuments of Delhi and Agra, and in the construction of the famous Taj Mahal at Agra. In Rajputana, at Jeypore, and Khansa, a large trade is done in the manufacture of idols out of the Makrana

marble. They are first carved and then brilliantly coloured with red, green, yellow, and blue paint, and gold. The idol trade is also a prosperous one at Tumkur, in Mysore, the masons of which place are noted for their skill in producing a highly-finished article. At Nagpur the same art once reached a high degree of perfection; but it has now to some extent fallen into disuse, although there are yet to be found many excellent carvers among the masons. At Nilgri, close to Balasore in Orissa, a black marble is obtained which is worked by the natives into various fanciful shapes. A black marble is also obtained near Ketri, which is in much demand for carving purposes. At Coimbatore, in Madras, there is a marble which varies in colour from pink to grey and white. It takes a fine polish, and is worked to a considerable extent. In Assam there are quarries of a grey veined marble; and at Durba in Bengal, a marble is raised which is of a deep black. A very fine marble, which is of extremely compact texture, and takes a high polish, is found at Bellary. It is of a yellowish cream colour, beautifully marked and shaded.

Several marbles have been discovered in the Australian colonies, but until lately they have been little worked. There seems likely to be a considerable development of the industry in this part of the world in the near future. At Tamworth, in New South

Wales, there are some quarries which produce a red, fossilized marble, which is very similar in structure to the Derbyshire fossil marbles. At Marulan there are mottled and grey coralline, and very fine black marbles. Cow Flat produces a white marble, which has been used in conjunction with Marulan black in the flooring of the great hall of the Sydney University. Maclean produces a dark purple and red marble, which has a beautiful appearance when polished. At Wallerawang there are thick beds of coralline marble of various tints—white, cream, and dove-coloured—some of it with pink markings. This marble is very compact, dresses well, takes an excellent polish, and may be obtained in blocks of almost any required size and quality. These beds are about seven miles from the Wallerawang railway station.

Serpentine of pale and dark green colour sometimes mottled with white, forming a fine ornamental stone, exists in a considerable quantity in the Burgera, Grafton, and Young districts in New South Wales.

In Otago, in the district of Oamuru, there is found a coarsely crystalline white marble, which takes a good polish; the same district also produces a fine white granite with large felspars. Several granites are found in these colonies—notably, the grey granite of West Island, near Port Victor, which has been used in the building of the new Parliament House at Adelaide,

and the white granite of North Green Mount, Western Australia. A species of porphyry is found near O'Connell Town, Brisbane. It is of very compact texture, and of a light, reddish-brown colour; it has been extensively used in the building of the Roman Catholic Cathedral, and of the Government Printing Offices at Brisbane.

The Cape Colony possesses several deposits of marble. That found near Troe Troe has a white ground covered with fine light blue veins. It is of a good, compact texture, and polishes well. A similar marble is found in Natal. This colony also produces a white crystalline marble and a grey granite. The latter, however, is of very coarse texture and little used. A large deposit of a pure white crystalline marble has been lately discovered in Alfred County, Natal. It is of very large extent, and situated near the banks of the Umzinkulu River, a few miles above Port Shepstone. It is very hard—of somewhat coarse texture; the crystals are large, and the marble very much resembles that of Mount Pentelicus. Samples of it have been lately brought to England. The owner claims to be able to place his marble upon the English market at a cost which will not exceed that of Italian. It remains to be seen whether it can be usefully employed in this country. An examination of the samples tends to the conclusion that the new find will share the objections

which operate against the use of Pentelican marble. It looks likely to be "plucky" and hard to work. It is perhaps only fair to add, that the workings are not yet opened up, and that the bottom beds may be of much finer grain than the top rock.

Chapter XI.

AMERICAN MARBLES.

THE rise and progress of the marble trade in the United States of America has been of a most extraordinary character. The first marble quarry in the country was opened in Vermont in 1785. Shortly before the year 1800, works were erected for the sawing of marble at Marbledale, near New Milford, Connecticut. It is said that the first tombstone made out of American marble was erected in 1790, and was the work of one Jonas Stewart, a marble-cutter of Dorset. An examination of the headstones in the graveyard at New Milford, proves that the oldest of them are of sandstone from the Connecticut Valley, and of slate. Those of somewhat later date are of marble, and have been evidently worked by hand from the rough block. Those bearing a date soon after the beginning of the present century have been cut on one or both sides with a saw. The date of the first working of American marble is therefore fixed with tolerable certainty, and it is evident that a trade which has now assumed enormous proportions has been built up in less than a century.

Marble is now used for building purposes in the States on a scale which may astonish the architects of the Old World. In New York it is superseding the brown freestone or sandstone, of which such a great part of the city is built. The great bulk of the trade centres in Vermont. In that State the quarries are worked with every mechanical means which the ingenuity of man has been able to devise. In the year 1882 it was calculated that the capital invested in the production of American marble in the States of Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Maryland, and Tenessee, was £2,500,000 sterling, two-thirds of which was invested in quarries and one-third in mills and machinery. The number of workmen engaged was 6,000, and the annual production amounted to 2,200,000 cubic feet, valued at £900,000.

The principal workings in Vermont are at Sutherland Falls, Rutland, and Dorset. The Sutherland Falls marble is mottled and veined in a manner peculiar to itself. Some of it is dark, with a ground of deep blue with nearly black veins. Another variety is nearly white with clouded veins. Both descriptions are sound, and take a good polish. Quarrying operations were commenced in 1836, although they were not pursued with much spirit until some years later. The quarries are well situated, above the railroad and mills, so that blocks are readily transported. The falls of

the Otter are made use of as a motive power to drive the saws, the polishing beds in the finishing shops, and the drills in the quarry. It was here that the first successful channelling machine was employed. These machines are now in operation all over the States. It is calculated that since 1863 over five millions of square feet have been cut by them. The channeller is a locomotive machine which runs on steel rails placed on the quarry floor. The gang of cutters forming the drill is composed of five steel bars, 7 ft. to 15ft. long, sharpened at the ends, and securely clamped together. The centre cutter is the longest, and the two outside cutters are the shortest, so that the five form a kind of stepped arrangement away from the centre. As the machine runs backwards and forwards over the rails the cutters deliver their strokes at the rate of 150 per minute. Deep, narrow furrows are cut into the solid stones, and long parallel blocks are thus formed. Close after the channeller runs the gadding machine. This drills circular holes along the bottom and sides of the blocks, into which wedges are introduced, and the stone is split from the bed. The Wardwell channelling machine, which is most commonly in use, cuts a continuous groove at the rate of 75 to 150 square feet per day, thus doing the work which could be done by 50 to 100 men by the old hand process. The expense of working the machine

is about £2 per day. The advantages gained by use of the machines are therefore obvious. The diamond gadder does its work at the rate of about 180 ft. per day as against 12 ft. by hand labour. Three men are required for each channeller, and two for each gadder. As a consequence of this mode of getting the stone, the quarry appears like a hollow cube cut into a hill. The sides are nearly perpendicular walls, and the bottom is a marble floor over an acre in extent. Across this floor the channelling machines work.

Sutherland Falls marble is much used for building purposes. The spire of Grace Church, New York, is built of it. The formation of the beds gives great opportunities for the extraction of large blocks. A small town has been built near the Falls for the accommodation of the workers.

At Rutland, a pure white marble is found. There are several quarries in the neighbourhood of the town, and the marble bears a high reputation. There are quarries of clouded and veined white, and of dove-colour as well as statuary. The marble is found on the western slope of a range of low hills running north and south. The thickness of the beds worked varies from 50 ft. to 120 ft. They are inclined at an angle which averages about 45°.

Quarrying operations were commenced in the year 1838, and a few years later trade in "Rutland marble"

had become firmly established. The deposits proved to be abundant and of sound quality, and were sources of large profits to the proprietors. The marble industry of Rutland has been a prosperous one, and at the present time it is calculated that some 2,000 men find employment in the quarries, mills, and workshops. Rutland statuary is said to be too soft for ordinary purposes. This complaint may possibly arise from the fact that the principal supply has hitherto been produced from the upper layers. It is now claimed that the lower layers have produced a statuary which is of a much better texture than any formerly worked. At the State House in Montpelier there is a statue of Ethan Allen, of heroic size ; this is the work of Larkin J. Mead, and is sculptured out of Rutland marble. The marble is certainly not so easy to work as that of Italy ; it is what is called "plucky"—that is, given to breaking away before the chisel, unless great care is used.

The sand blast was first employed for the cutting of marble at some marble works in West Rutland in 1875-76. A contract was taken by which 254,000 lettered headstones, having dimensions of 3 feet in length, 10 in. in width, and 4 in. in thickness, were placed in the national cemeteries at an expense to the Government of about £173,000. The monuments were for the purpose of marking the graves of soldiers,

and the application of the sand blast for the purpose of cutting the inscriptions, enabled the work to be so cheaply done. Letters and figures of chilled iron were placed on the stone to be cut, and the blast was then turned on; the portions of the stone unprotected by the iron were eaten away by the force of the blast, and the inscriptions were left standing in relief. By this method the name, company, regiment, and rank of a soldier, could be put upon a stone in less than five minutes of time.

Between Rutland and Sutherland Falls there is found the quarry of the Columbian Marble Company. This marble is almost black, but with a mottled surface; it is much used for mantelpieces and monuments.

At Pittsford there are three beds or veins of marble which run through the town north and south. The east bed is of the same character as Sutherland Falls marble, of which bed it is probably a continuation; the middle bed is separated from the easterly one by about 200 ft. of limestone rock. This bed is about 400 ft. wide, and contains marble of all shades, ranging from white to dark blue. Marble from the Pittsford quarries has been used in the construction of several large buildings at Boston—notably the Continental Building, Commonwealth Hotel, and the Blackstone National Bank Building.

About a mile to the south of Pittsford some marble is quarried known as "Florence marble." It is dark blue in colour, mottled, and veined. The quarries were first opened in 1880, and the production rapidly assumed large proportions. In 1884 it was calculated that the output was nearly 10,000 tons.

Another dark, dove-coloured marble is found at Brandon. Several quarries have been opened near this town, but only one is now in active operation.

At Middlebury there are extensive deposits of white marble, which some years ago were very largely worked. Little in this way has been done of late, as the marble, although of good colour, has proved to be so generally unsound that the working of it has not been remunerative.

The first attempt to manufacture marble upon a large scale which was made in the States originated in Middlebury. In a history of this town by Judge Swift, there is an interesting quotation from a pamphlet written by Professor Frederick Hall, and published as long ago as 1821, which is as follows:—

"Proceeding down the creek on the western side, after passing two saw mills, two grist mills, a clothier's works, and some other establishments of minor importance, you come to the marble factory. The marble of this village, which is now wrought on a large scale, and is extensively approved over the country, was

discovered by Eben W. Judd, the present proprietor, as early as 1802. A building on a limited plan was erected, and machinery for sawing the marble was thus put in operation. In 1806 a new and commodious building, two stories high, and destined to comprise 60 saws, to be moved by water, was erected. In 1808 this enlarged establishment went into operation, and has continued to the present day.

"The saws are made of soft iron without teeth, and are similar in form to those which are used for sawing marble by hand in the large cities in Europe. The marble until lately has been obtained chiefly from a quarry situated within a few feet of the mill. It is raised from its bed partly by means of wedges, but principally by blasting. The marble, after being sawed into slabs, is manufactured into tombstones, curriers, tables, panels, mantelpieces, hearths, window and door-caps and sills, sideboards, sinks, and various other kinds of furniture. These articles are transported to Montreal, Quebec, Boston, New York, and even Georgia. The machinery has sawn annually from five to ten thousand feet since the year 1808."

At Lanabee's Point, in Shoreham, Addison County, there are deposits of black marble which closely approach Kilkenny marble in appearance. The quarries are not now in active operation, but several polished chimney pieces made of it are to be found in some of

the older houses in the neighbourhood. At one time it appears to have been in much favour.

La Motte marble is another black marble of similar character, but more fossilized. It is found near the west shore of the Island of La Motte in Lake Champlain. It is in considerable demand for the making of flooring tiles, and finds some employment for monumental purposes.

At Swanton, in Franklin County, there is found a dove-coloured marble, which was much used for grave-stones down to the year 1850. In that year the workings were abandoned, as the quarries could not compete with those opened at Rutland.

South of Rutland the celebrated Dorset marbles are found. These are situated near the town of that name, in Bennington County, Vermont, and are, for the most part, worked in the sides of Dorset Mountain or Mount Eolus. This is a mountain of marble with a cap of slate on the top. The slate is estimated to be 498 feet in thickness, and the limestone and marble 1,970 feet. Some 200 feet below the slate white marble used for building purposes is quarried, and 400 ft. lower a fine-grained white marble is found which is in great request for monumental purposes. The first quarry was opened in 1785, and saw-mills were erected in South Dorset in 1818.

Before that date the stone was taken from the top

or outer edge of the layers, where the the strata could be readily split into flags of a thickness of some four or five inches. These flags were then worked up into the required shape with mallet and chisel. When once sawing plant was in full swing, the harder layers of stone were worked, and the sawn marble found a ready market. In 1840, before the introduction of Italian and Rutland marble, the demand for Dorset marble was beyond the supply.

What is known as Vermont Italian marble is worked up the mountain at East Dorset. This marble is almost exclusively used for monumental and decorative purposes. The production reaches an annual average of over 30,000 cubic feet.

A quarry known as the Freedley Quarry, situated a little further to the north, has been worked since 1820, and is still producing a white marble, much used for building purposes. The quarry is high up in the mountain, and the blocks are sent down by means of an inclined railroad. The annual production of the Freedley Quarry, averages 40,000 cubic feet.

At North Adams, Massachusetts, there is a quarry of white marble, coarsely crystalline. Blocks were formerly produced from this quarry; but it is now almost entirely worked for stone, which is ground up and sold for marble dust.

Further south, at Lee, extensive quarrying operations

are carried on. From the quarries in this neighbourhood the material was supplied for the extension of the Capitol at Washington, and the City Hall at Philadelphia. In the building of the latter, 702,000 cubic feet were used, some of the blocks being of very large size, and weighing singly over 20 tons.

The town of Sheffield formerly produced a white marble, which at one time enjoyed considerable reputation in consequence of the very large size of the blocks in which it could be obtained. The large columns of the Girard College, Philadelphia, are of this marble, which with great labour was carted across the hills to the Hudson River, whence it was shipped to Philadelphia. The quarries have not been worked for some time.

Abandoned workings are also to be found at Canaan and Marbledale. At Marbledale, the first sawmill erected in the States was built by Philo Tomlinson, about the year 1800. He used soft iron toothless saws stretched on a frame forming a gang. The gangs were driven by water power, and the saws were fed with sand and water equally distributed by an automatic arrangement, for which a patent was granted to him. For many years the business was prosperous. In 1830 as many as fifteen quarries were actively worked, and a like number or more mills were in operation within a distance of three miles of the town. When, however,

the Vermont marble came into the field with a better quality at a lower cost of production, the marble trade of Marbledale was doomed, and the workings were ultimately stopped. East Canaan furnished the marble for the new State House at Hartford. This marble is fairly white, but the quality is uncertain. It is not suitable for monumental purposes, but has been much used for building. At the sawmills which were erected at this place the saws were toothed with diamonds. The carbons were set in pieces of steel or iron, and these patches were brazed into the blade of the saw It is stated that they were wonderfully effective, sawing the blocks of marble very rapidly.

At Dover, in New York State, quarries of white marble have been extensively worked. Dover marble is of fairly fine grain, but it does not take a high polish. Two coloured marbles are raised near Chazy and Plattsburg in Clinton County. They are known as "Lepanto" and "French grey." The former is composed of pink and red fossilized shells in a reddish ground. The latter is of similar character, but with a darker ground. Both these marbles have been much used for furniture and interior decoration.

The white marbles of Maryland will not compare in point of quality with those of Vermont, but considerable quantities are raised and used for building purposes. The principal quarries are situated near

Cockeysville and Tescar in Baltimore County. A very large trade in marble is done at Baltimore, not only in the Maryland marbles, but also in that which is imported from other States and from Italy. Some of the finest buildings in the country are constructed of Maryland stone. The Washington Monument and the platform and columns of the National Capitol are made of the white marble, and the Baltimore City Hall is built of it. This stone is very sound and compact in texture. It is capable of being quarried in very large sizes, blocks 28ft. by 10ft. by 3ft. have been raised.

At Point of Rocks there is a deposit of a very fine breccia known as "Calico" marble. It has been used in the construction of the columns of the old Hall of Representatives at the Capitol building in Washington.

Near Dublin, in Harford County, there are quarries of green serpentine, which have been largely developed during the last few years; and, in Frederick County, a marble very similar to Verd Antique is exclusively worked.

The marble and granite quarries of Maryland employ about 850 men. The quarries are not so carefully worked as in Vermont. In some of them the drilling is done by machinery, but the principal part of the work is got through by manual labour. In the quarries near Baltimore, Italian and negro labour is being introduced. The quarry hands work about nine months

in the year. A foreman who superintends the drilling receives from 8s. to 10s. per day; drill hands, 6s.; labourers and teamsters, 5s.; coloured labourers can be obtained for about 4s. The town of Baltimore supplies most of the monumental work done in the State. The marble cutters there work principally on imported Italian marble. The best of them receive from 10s. to 12s. per day. Expert carvers get 16s. Letter cutters are mostly paid by the piece, the price being in accordance with the style of work. A good man can earn about 12s. per day. Rubbers and polishers get from 6s. to 8s. per day. The men work ten hours in summer, and from eight to nine hours in winter. Men engaged to set the stone on buildings get 13s. per day. This is the Union price. Most of the stone used in house building in Maryland is either cut in Baltimore and sent from there ready worked, or is cut on the building site by Baltimore hands.

Alabama possesses an excellent white marble known as "Talladega." There are also quarries in this State which produce a grey and white non-crystalline variety, and several variegated marbles.

At Marietta, in Pinches County, North-East Georgia, there are some extensive works which have been formed to operate upon the marble that is raised in that district. This country will be opened up by the construction of the Marietta and North Georgia Railway. The deposits

of marble are of large extent. In one valley there is a solid mass 5,000ft. in length, and over 2,000ft. in width, and the beds are found to spread over a space of some 7,000 acres. The quarries now in work are four in number. The Kennesaw quarry produces a limited quantity of a pure white marble, but the bulk is of light ground slightly clouded with spots and dark veins, and is similar in appearance to Italian vein. The Creole quarry produces a marble with light ground and a finely mottled surface, and another with a light blue and grey ground, and darker veins. The Cherokee quarry produces marble of a similar character, but the markings are rather less decided. The Etowah quarry produces a great variety of coloured marbles, pink, red, and dark green, and variegated in many shades of these colours. Georgia marble is said to be very sound, highly crystalline, and dense, and to be non-absorbent in a degree which few marbles can equal. This last quality is one which should make it very useful, if the cost of working is not too high. The marble can be obtained in large sizes, blocks weighing upwards of 25 tons having been raised.

Hawkins County, in Tennessee, produces a marble which varies in colour from light pink mottled with white through all shades to deep chocolate red. It is very close and compact in texture, with almost absolute freedom from flaws. It has been employed in the

Capitol building at Washington, and is much in request for general decorative work.

A very fine fossil marble is found in the beds of Devonian limestone near Charles City, Iowa. The rock is hard and fairly sound; it is non-crystalline, and is full of fossil shells and corals. The colours are somewhat dull; they vary from light drab to dark brown. The surface takes a good polish, and shows to advantage the fossil remains, sometimes 8in. and 10in. in diameter, which are imbedded in the matrix.

In Illinois, a stone known as "Lemonte marble" is extensively quarried; this has been largely used in the building of Chicago. Kansas possesses some very good black marbles, and one of a light cream colour, which is soft and easily worked.

In Swain County, North Carolina, near the junction of the two branches of the Western North Carolina Railroad, there is an extensive deposit of coloured marbles. Some of them are green, blue, and pink, some black and white; they are all capable of taking a high polish, and are very sound. These marbles have been lately used in the construction of the new Governor's House at Raleigh, N.C.

In the Rocky Mountains and all through the Pacific States marble is found in large quantities. In Colorado there are deposits of white, green, and clouded marbles, and of a well marked brecciated variety. California is

especially well favoured in this respect. Nine miles north of Ione, in Amador County, there are quarries of white marble, which make an excellent building stone. In Calaveras County there is a deposit of a pearl-grey marble with dark markings, which takes a high polish. Near Newcastle, in Placer County, there is a large quarry of marble, which varies from pure white to grey, and which polishes well; the Folsom Prison is entirely built with this stone. The quarry was opened in 1877, and has been extensively worked. A very beautiful mottled grey marble has been lately found near Eureka, in Humboldt County. In Tuolumne County there are also very extensive deposits; most of it is of an unclouded white, fine grained, and extremely hard. Near Suisun there is a singular stone, which in its rough state looks very much like rosin; it occurs in large masses, from which blocks of enormous sizes have been cut. On the McCloud River there is a white statuary marble. It appears to be of fairly good quality, but very little of it has been hitherto worked.

The Inyo marbles are found in the range of mountains of that name. They are dolomite marbles, and vary in colour from pure white through all shades of rose-red, grey, brown, and green to nearly black. They have been selected as the building material of the Sharon Gate, at Golden Gate Park, San Francisco. A useful brecciated yellow marble is found at Tehachipi,

in Kern County, and a species of Onyx marble is found near a mineral spring six miles above Kernville. In Monteroy County, near Carmelo Bay, there are deposits of white marble, to work which, the Pacific Carrara Marble Company was incorporated some years ago. Nevada produces a dark grey veined marble, which is found at Bear Creek, three miles from Colfax; and the same district produces a very compact black marble, veined with white, which is found close to the Central Pacific Railway, about a mile from Colfax. Santa Cruz County produces a dark fossil marble, which is quarried about seven miles north-east of the town of Santa Cruz.

The Californian quarries also yield handsome specimens of Cipolin marble, white with shadings and streaks of green, and a marble very similar to the Black and Gold of Italy. There is also raised a variety known as "Ruin" marble. This is a yellowish stone, with broken lines supposed to resemble the ruins of fortifications.

It is somewhat singular that with such a profusion of excellent marble throughout the State, the Californian demand, which is always heavy, is principally met by importations from Italy. It is a testimony to the sterling worth of the Italian marbles which speaks volumes.

In the matter of literature the marble and granite

trades of the United States are well cared for. There are two trade journals devoted to their interests. The *Reporter* is published monthly in Chicago. It is conducted with a considerable amount of ability. It is representative principally of the master marble workers and dealers. Another paper is known as the *Granite Cutters' Journal.* This more especially takes up the representation of the operatives who are engaged in the trade. Like the *Reporter*, it is a monthly publication. It emanates from Philadelphia.

Chapter XII.

A COMPARISON OF THE BEST KNOWN MARBLES.

THE following list comprises one hundred of the marbles best known to commerce. It is arranged so as to facilitate selection of material.

WHITE MARBLES.

Name.	*Where quarried.*	*Notes.*
Sicilian	Italy	Clear white, with bluish cast. Hard. If carefully selected bears exposure well. Serves well for monumental purposes, for steps and staircases.
Vein	,,	White ground. Veined.
Statuary Vein	,,	Statuary ground, more or less veined.
Statuary	,,	Rarely obtained pure. Statuary of Carrara best.
St. Béat	France	Very clean, but not to be compared with that of Carrara.
Onyx	Algeria	Semi-transparent. Yellowish white, sometimes veined.

BLACK MARBLES.

Derby Black	England	Deep black. Close texture, polishes well; thickest bed, ten inches.
Irish Black	Ireland	Deep black. Fairly easy to work; best bed, eleven to thirteen inches thick.
French Black	France	Generally more or less spotted, and of inferior quality.
Belgian Black	Belgium	Best black marble known. Very hard; beds, four inches to two feet thick.

GREY MARBLES.

Name.	*Where quarried.*	*Notes.*
Dove	Italy	Can be obtained lavender grey and dark grey, with slight veining. Texture like Sicilian, but harder.
Bardilla	,,	Grey, with dark veins Hard and brittle. Often venty. Easily breaks in working.
Pettit Tor	England	Hard. Takes good polish.
Ashburton	,,	Grey, dark veins.
Derby Fossil	,,	Grey ground, fossils white. Very hard. Polishes well.
Kilkenny	Ireland	Black ground, with dark grey patches. Fossils white.
Irish Fossil	,,	Dark grey ground.
D'Héchette	France	Dark greyish black ground, veined with white. Can be obtained in large blocks.
Grand Antique	,,	Black and white, showing sharp contrasts.
Black Vein	,,	Black, with large white veins.
Luma Chelle	,,	Grey ground, with fawn-coloured patches, slightly tinged with red.
Bianco e Nero Antico	Algeria	Black, with white veins.
St. Annes	Belgium	Dark grey and black, marked with white, flowered and veined. Very sound. Compact texture.
Blue Belge	,,	Dark grey and black, straight white veins. Sound.

GREY MARBLES—*continued.*

Name.	*Where quarried.*	*Notes.*
Historique - -	Belgium	Fossil marble, black ground white veins.
Jaune Oriental - -	,,	Reddish grey. Hard. Fairly sound. Takes high polish.
Belgian Fossil - -	,,	Grey ground, with white spots and markings.
Florence - - -	,,	Dull grey tint. Fossiliferous marble.
Belgian Grand Antique	,,	Black, with large white veins.
Belgian T - - -	,,	Grey, with patches of dull brownish red.
Coquillé - - -	,,	Black ground, with white spots and veins.
Gris de Barse - -	,,	Dull reddish grey, with markings of brownish red.
Lilas - - -	,,	Dull greyish-brown ground. Very little marked.
St. Amande - -	,,	Dull dove colour, with reddish tint.

GREEN MARBLES.

Verde di Levanto	Italy -	Dark green, interlaced with purple and red veins.
Verde di Pegli -	,,	Dark green, with fine white veins. Venty.
Verde Antique -	,,	Deep green, with white veins, Soundest of the Genoa marbles.
Verde di Prato -	,,	Dark green, with dark spots, veined with white. Polishes well. Small blocks only.

GREEN MARBLES—*continued.*

Name.	*Where quarried.*	*Notes.*
Genoa Green	Italy	Dark green, with dark patches, and white and grey veins.
Purbeck	England	Greenish grey, mottled. Small blocks only.
Connemara	Ireland	Green, with patches and veins of grey and black. Venty.
Duporth	England	Mottled green. Very soft. Easy to work. Does not polish well.
Vert Moulins	France	Red ground, interlaced with green patches and veins, and white spots.
Vert Maurin	,,	Dark green ground, veined with white. Large blocks. Sound.
Vert d'Arriege	,,	White ground, marked with light green and dark green veins.
Vert Isabelle	,,	Ground of fawn colour, with dark green and white veins.

RED MARBLES.

Rosso di Levanto	Italy	Deep purplish red, with lighter veins. Venty.
Verona Red	,,	Light red, with fawn-coloured patches. Fairly sound.
Red Ogwell	England	Deep red, very finely marked.
Draycot	,,	Red conglomerate. Very hard. Does not polish well.
Victoria Red	Ireland	Light red, mottled. Fairly sound.
Rouge Acajou	France	Rose red, mottled. Can be had in large blocks. Polishes well.
Sarrancolin	,,	Red, with fawn and dove markings. Large blocks.

RED MARBLES—*continued.*

Name.	*Where quarried.*	*Notes.*
Isabelle	France	Dark red, with fawn-colour spots, and dark greyish-green veins.
Languedoc	France	Bright red, with large white veins.
Rouge Antique	,,	Dark red. Small blocks only obtainable.
Rose	,,	Something like Griotte, but not so well marked. Sound. Polishes fairly.
Rose Enjugeraie	,,	Red, with patches of pearly grey, and bright red veins.
Brocatelle Violette	,,	Purplish red, with patches of grey and yellow.
Griotte d'Italie	,,	Most esteemed red marble. Deep red ground. Network of black veins. White shells interspersed.
Rosa Carnagione	Algeria	Ground of flesh colour, marked with yellowish patches, and red veins.
Breccia Sanguina	,,	Very deep red, with lighter patches of same colour.
Rouge Etrusque	,,	Dark red ground, with brown veins and spots. Here and there marked with bright yellow. Polishes well.
Rouge Royal	Belgium	Dark red, grey veins, patches of red and white. Venty.
Rouge Griotte	,,	Dark red, white veins. Best red Belgian marble.
Rouge Fleuri	,,	Dark red, white flowered veins.
Malplaquet	,,	Brownish red, grey and white veins.
Rouge Rose	,,	Red, with grey and white veins.
Iberian Agate	Portugal	Purplish red, with yellow and brown markings.

RED MARBLES—*continued.*

Name.	*Where quarried.*	*Notes.*
Emperor's Red	Portugal	Light red. Very bright. Takes high polish.
St. Sylvester	,,	Very handsome flesh-colour ground, dark red and white veins, light brown and white patches. Sound. Takes high polish.

BROWN MARBLES.

Penmon	England	Light brown ground, well mottled with grey and dark brown.
Bird's Eye	,,	Brownish grey, full of fine spots of lighter colour.
Dog Tooth	,,	Reddish brown, full of fossils, with serrated edges.
New England	,,	Purplish brown, with grey veins.
Russet	,,	Deep brown, mottled.
Lunel	France	Light fawn colour. Very little marking.
Lunel Fleuri	,,	Same ground as Lunel, but flowered with dark brown.
Joinville	,,	Same ground as Lunel, mottled with brown and red.
Napoléon	,,	Same ground as Lunel, with fine red and brown veins.
Comblanchien	,,	Light brown, even colour, and good texture.
Jaune Oriental	Belgium	Reddish brown, well mottled with grey, red, and pink.
Waulsort	,,	Dark brown, with fragments of white, black, red, and pink. Fairly sound. Takes good polish.
Istrian	Austria	Light cream colour. Fine even texture. Good weather stone.

YELLOW MARBLES.

Name.	*Where quarried.*	*Notes.*
Pavonazzo	Italy	Yellowish white ground, with purple and black veins.
Pavonazetto	,,	Yellowish white ground, with finer veins than Pavonazzo.
Sienna	,,	Ground brown to white, through all shades of yellow, veined with purple and black.
Black and Gold	,,	Black ground, with large yellow and white veins.
Jaune St. Beaume	France	Yellow ground, with fine red and brown veins.
Brocatelle Jaune	,,	Yellow ground, with brown and white veins.
Jaune Lamartine	,,	Rich yellow ground, veined with fine pencillings of red and brown.
Rouge du Var	,,	Yellow ground, with irregular small patches of red and white.
Brêche St. Antonin	,,	Yellow ground, with red and brown patches. Polishes well. Very unsound.
Médoux	,,	Brecciated marble, with patches of black, red, yellow, and white.
Grammont	,,	Similar marble to Médoux, but less yellow, and not so finely marked.
Brêche Portor	,,	Greyish black ground, covered with very fine pencillings of brown and yellow.
Jaune Victoria	Germany	Dark yellow, with fine red, purple, and white spar veins.

YELLOW MARBLES—*continued.*

Name.	*Where quarried.*	*Notes.*
Giallo Avorio -	- Algeria -	Cream colour, with pink and yellow markings, and red veins.
Giallo Canarino	- ,,	Yellow ground, with pink and red veins.
Giallo Antico -	- Tunis -	Reddish yellow of many shades. Close texture. Takes high polish.

Chapter XIII.

PRACTICAL.

THE information contained in the preceding chapters would be incomplete without some consideration of the manner in which it may be best turned to practical account. Improved modes of transit by land and by sea have given to architect and to marble worker a selection of material which a generation ago it would have seemed impossible to obtain. At the same time, and partly for the same reason, the item of cost has been vastly reduced, and as a consequence a most serious obstacle to the use of marble as a decorative material has been removed. The marbles of the whole world are to day at the disposal of the architect. The practical question for his consideration is where and how to use them.

In northern climates the use of marble is almost entirely confined to indoor purposes. The beauty of the coloured marbles does not appear until they are polished, and no marble will retain a polished surface for long under exposure to the weather. As a general rule, therefore, marble is unfit for outside work. The principal exception is that of the hardest Sicilian

marble. The beauty of this stone is not dependent upon its retention of a polished surface, and if due care is exercised upon its selection it will bear exposure very well. The best Sicilian for outdoor purposes is of a perfectly even texture and colour—so hard as to emit a clear ringing sound when struck and of a highly crystalline formation. Veined Sicilian should never be used in situations in which it will be exposed to the weather. A decided vein marks the line where disintegration will commence.

To make the most and the best of veined and coloured marbles, a great deal depends upon the way in which a block is cut. It should be so sawn that the figure is displayed to advantage. These marbles are, however, usually employed in thin sawn slabs, and a buyer has little difficulty in finding that which best pleases his taste. With Sicilian and Statuary, which are frequently required in masses and in blocks, the selection becomes more difficult. Never select blocks in bright sunshine. The best time is on a cloudy day after a shower of rain, and early in the morning. If a block can be "looked into" at all, it will be then. In selecting blocks of Statuary, a sharp look-out should be kept for yellow spots or veins; they are less likely to be noticed than black ones, which are more easily discovered. Much of the Statuary imported from Italy is unfit for sculpture at all. It is very white, with a

bright sparkling crystal and a taking appearance; but it crumbles under the chisel, is of a soft sugary substance, and very quickly decays. The best blocks are hard and close-grained, and if of uniform tint are none the worse for a slightly yellowish cast; they work evenly under the chisel, and are not too transparent.

The best white marbles of Italy are eminently suited for sculpture. In no other material is it possible for the conception of the artist to be reproduced in permanent form with such satisfactory result. The hardness of these marbles, and the fineness of their grain give effect to the most delicate touches of the chisel. The purity of white marble is in itself an aid to the grace and beauty of the composition. It has one distinct advantage over bronze or any material which requires to be cast. The last touches in marble are those of the artist himself; in all cast work they are perforce those of the founder and his men.

Polished marble will not harmonize with a material which presents a rough surface. It does well with glazed tiles, burnished metal, and polished woodwork. It is very suitable for the ornamentation of fireplaces. For this purpose an unpolished stone is apt to become dirty, and the employment of wood is attended with danger. In all situations in which bare stone is left to be touched or brushed against, marble is the only material to be tolerated. It is not enough for the architect to see

samples of the marbles which he means to employ. He should be careful to inquire into the soundness of the material, and of the size of the blocks which can be procured. He should also see samples which are of sufficient size to give a good idea of colour and effect. Some marbles may be obtained in which colour and texture are fairly average throughout large slabs or blocks. In others there is an entire difference in the space of a few inches. Some marbles are only to be obtained in small blocks, and it is useless to specify them for situations in which single pieces of large size are required. Some marbles are so full of earth cracks and vents that they are quite unsuitable for any work in which they are required to give support, as, for instance, in the matter of columns. It is not long since that the columns of a new church built in Paris were constructed of a marble which was unfit for this particular purpose. The result was that even before the building was completed weakness was exhibited in the shape of several formidable cracks in the columns, and in the end the whole of the work was taken down and re-built. A vast amount of trouble and disappointment may be saved by a little inquiry before a specification is decided upon.

It will be found that the adoption of this step will almost always result in a very considerable saving of cost. Of two marbles which produce a similar effect,

the one may cost in working three times as much as the other. In some situations it may be an advantage to build up intricate mouldings out of thin slabs. Working out of the solid may mean the spoiling of a design or a cost which becomes prohibitive. The selection of the marbles with which different parts of a design are to be carried out is of more consequence in the matter of cost than appears at first sight. Other factors being equal, it is well for the stone which is most easily manipulated to be employed in those portions of a design in which there is most work. Too frequently the consideration of these matters is left until after a plan is made and a specification prepared. In such cases money is thrown away which might have been usefully employed in another direction, the work is altogether abandoned, or the inquiries which should have been made first are made last, at an expense of time and trouble which might have been easily saved.

The harder marbles afford excellent material for the construction of steps and staircases. Marble steps are not only beautiful in appearance, but they are calculated to withstand an enormous amount of wear and tear. In selecting marble for this purpose, it should be remembered that the effect of a flight of steps depends upon the regularity and evenness of the lines, and the simple alternation of light and shade in the tread and riser. Coloured marbles with strong

markings or veins are not suitable. The self-coloured marbles or one of the dull grey varieties should be employed. The even colour of Sicilian, Comblanchien, and of the Istrian marbles, makes them especially useful for this purpose. The effect which should be produced by a fine flight of steps is ruined by the employment of a marble in which the veins run obliquely and distort the horizontal lines, or in which waves of colour disturb the effect of simple breadth of light and shade. These remarks apply equally to moulded work. Heavily-veined marble destroys all the beauty of the lines of mouldings. As far as possible, work of this description should be carried out in plain black, white, or grey. Generally, finished work in marble is polished. The effect of reflection from a highly-polished surface should be carefully borne in mind, otherwise it will be found that some members of a moulding will be completely obliterated in certain lights.

The variegated marbles should be reserved for flat surface decoration. Due care should be taken that the size of the panel or slab is sufficient to display the variety of the markings. If this is not done, half the beauty of the marble will be lost. In small panels, a marble which has close, fine markings should alone be used. The only exception to the general rule as to the employment of veined or variegated marbles is in the case of columns. The smooth cylindrical face of

a column shows off the beauty of the markings as well as, or better, than a flat surface. If the column is fluted, the objections to these marbles again return in full force.

Marble may be most usefully employed for the paving of halls and passages and of rooms in which much traffic is expected. A floor of marble mosaic is one of the most beautiful, and at the same time, one of the most durable which it is possible to construct. Marble tile floors are very common in churches and public buildings in Continental Europe. Their cost as compared with tiles made of clay has operated against their employment in England. Modern machinery and competition have now removed this obstacle, and marble tiles can be obtained which very little, if at all, exceed the cost of the ordinary encaustic tiles. If a clay tile pavement which has been much used is examined, it will be found that each tile is worn more or less hollow in the centre. A similar traffic over marble tiles produces a scarcely perceptible result.

Some most useful rules with respect to the employment of marble have been laid down by Mr. T. Graham Jackson. They are as follows :—

"1. Decorative carving in marble—as, for instance, in cornices, capitals, and friezes, where high relief and bold design are required—should be severe and conventional. Naturalism is forbidden by the stubbornness

of the material except in the highest subjects, such as the human figure, which repays the expense of labour, or else in very low reliefs, where the labour of execution is reduced within moderate limits.

"2. Sculpture should be in white marble, or if in alabaster, only in such as is free from veins or stains of colour.

"3. Moulded architectural features, such as vases, bands, strings, cornices, architraves, and abaci, should be either in white or some uniform colour, without markings or veins.

"4. Variegated marbles should be used only for panels or columns, or, in other words, on plain smooth surfaces, either flat or curved, so as to display the beauty of their markings to the utmost, without interfering with any of the structural lines of the architecture.

"5. Coloured marbles should be used with moderation, too great a variety being avoided, and those of the quieter and more harmonious tones preferred for general use.

"6. Strong contrasts of colour on a large scale are dangerous, and generally incline to vulgarity.

"7. Strong contrasts on a small scale, as in mosaics and inlaid work, are necessary.

"8. Stone and marble should be kept apart as much as possible."

The application of machinery to the working and polishing of marble is of very ancient date. Saws without teeth, fed by hand with sand and water, were used to cut the slabs with which the walls of the palace of Mausolus at Halicarnassus were lined. Pliny describes the saw, and the kind of sand with which the slabs were sawn, and speaks of the palace as being encrusted or veneered throughout with marble. It was built 350 years before the Christian era. Saw mills, for sawing stone, driven by water power, were in use on the little river Roer in Germany in the fourth century. Very little progress appears to have been made in this direction, because we find as lately as the early part of the sixteenth century, that one of the inventions of Leonardo da Vinci was a marble saw, which consisted of a frame in which two or more blades of iron were stretched, ; thus forming a gang. The honour of first establishing mills for the sawing of marble by means of water power in Great Britain and on an extensive scale, belongs to Mr. William Colles, of Kilkenny. About the year 1730, he tried a model in a small stream, and finding it succeed, took a perpetual lease of a marble quarry in the neighbourhood, and set up a mill, which is still in existence, and worked by his descendants. A few years afterwards (in 1748) machinery for sawing and polishing marble, by means of water power, was established at the village of Ashford, near Bakewell,

in Derbyshire. Since that time, a great many improvements in the details of sawing machinery have been introduced, but the arrangement sketched out by Leonardo da Vinci remains practically the same, and is in general use to-day. The principal improvements have been :—an arrangement by which sand and water has been fed to the saw automatically, and variations of a clockwork mechanism, by which the saws are gradually lowered into the cut, and which can be made to work fast or slow, according to the hardness of the stone to be sawn.

An entirely new method of sawing marble has been introduced into Belgium during the last few years. Instead of thin blades of iron, an endless cord composed of twisted wires is employed. The cord is revolved round pulleys which give it a forward and a rotary movement. It is then brought into contact with the marble and cuts it with the aid of sand and water. It does its work very quickly, but the principal objections appear to be the difficulty experienced in cutting true, and the large amount of room which is required to work the machine. It seems better adapted for use in a quarry than for the factory.

When marble comes from the saw the surface has yet to be smoothed and polished. It is first rubbed with fine sand, then gritted and pumiced, and finally polished by means of a block on which putty powder

or lead has been laid. The machines employed in Italy for surface-rubbing are of very rude construction. A bed of thick marble slabs is first laid down in a circular form, and a large wheel-shaped framing of wood, divided by spokes into four or five compartments, is made to revolve over it. The slabs of marble to be rubbed are placed in the compartments, sand and water is thrown on the bed, and the revolving wheel is set in motion. As it goes round it carries with it the slabs, which are thus rubbed on those below until the requisite fineness of surface is produced.

The rubbing bed principally used in England is of cast iron. A plate of this material some two or three inches in thickness and eight to ten feet in diameter is made to revolve quickly, and carries on its surface the sand and water required. The slabs are placed face downwards on the plate, and the required work is speedily and easily done. Another machine for rubbing large and heavy pieces of stone consists of a heavy iron plate eight to twelve inches in diameter pierced with holes and made to revolve by connection with a vertical shafting. The sand and water is placed inside the plate and finds its way out through the holes upon the work below; the weight of the revolving plate does the rest.

A number of machines have been invented for the purpose of carving marble, but none have proved

successful. All of them seem to have been on much the same principle. Two or more points were fixed in a frame which could be moved in every direction. One point was fixed; the others were made to revolve at a high degree of speed. They were all so arranged in the frame that the position of each was always the same in relation to the others. The manipulator placed a piece of finished carving under the stationary point, and as many rough blocks of stone as he wished to make into copies, one under each of the revolving points or chisels. As the stationary point was passed over the surface of the finished carving and raised or lowered as it was brought into contact with each portion of it, so the revolving chisels followed the position of the stationary point over the model, and cut away the stone placed underneath them into a corresponding shape. In some of these machines the table itself moved as well as the frame, but in all of them some modification of the same plan was adopted.

The sand-blast has been usefully applied for the purpose of cutting patterns in marble in low relief. The machines now in use are provided with a hopper, which is filled with sand and connected by means of a flexible tube with a pipe, through which a jet of steam is driven; the vacuum caused by the pressure of the steam draws the sand into the blast, by which it is thrown against the surface to be operated upon. A pattern or

stencil is laid upon the marble, and protects that portion which it is not intended to cut away. This process is useful for purposes in which a flat surface requires to be ornamented at a very low cost. The hardest black marble can be operated upon as easily as the softest statuary, the most delicate and intricate designs can be cut in a few minutes of time at a nominal expenditure. Upon self-coloured marbles without much veining this process shows to best advantage. The lines of the carving can be cut with the greatest possible truth and regularity.

Numerous plans and all sorts of extraordinary materials have been used and recommended for speedily polishing the sanded surface of marble. Practical experience proves that nothing in this process will take the place of good honest hard rubbing. This can be best applied by means of a very simply-contrived machine. A crank is connected with a fly-wheel and works an iron framing backwards and forwards, forming a rocker. To the rocker is fastened a shaft, which is connected to a large block covered with felt, on which putty powder or rouge and water has been sprinkled. The block is dragged backwards and forwards over the surface of the marble, and in no other way can a good lasting polish be produced. Acids are frequently employed to get up a superficial polish—but this method is utterly destructive in its results. A very short space

of time is required for the acid to eat away into the surface of the marble, when a dull, speckly appearance is produced. No acid should be brought into contact with marble during the polishing process.

MARBLE

FOR USE AND ORNAMENT.

—o—

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