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BOARD OF AGRICULTURE AND FORESTRY

DIVISION OF FORESTRY
C. S. JUDD, *Superintendent*

The Ohia Lehua Trees of Hawaii

A Revision of the Hawaiian Species of the genus *Metrosideros* Banks, with special reference to the varieties and forms of *Metrosideros collina* (Forster) A. Gray subspecies *polymorpha* (Gaud.) Rock.

BY
JOSEPH F. ROCK
Consulting Botanist



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ISSUED AUGUST 27, 1917



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LETTER OF TRANSMITTAL

Honolulu, Hawaii, March 1, 1917.

*Board of Commissioners of Agriculture and Forestry,
Honolulu, Hawaii.*

GENTLEMEN :

I have the honor to transmit herewith the manuscript of a paper entitled "The Ohia Lehua Trees of Hawaii," which is a revision of the Hawaiian species of the genus *Metrosideros* Banks, with especial reference to the varieties and forms of *Metrosideros collina* (Forster) A. Gray subspecies *polymorpha* (Gaud.) Rock, by Mr. Joseph F. Rock, *Consulting Botanist of the Division of Forestry and Botanist of the College of Hawaii*, and to recommend that it be published as Botanical Bulletin No. 4 of the Division of Forestry.

Very respectfully,

C. S. JUDD,
Superintendent of Forestry.

Approved:

*Board of Commissioners of Agriculture and Forestry,
March 8, 1917.*

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PREFACE

The writer of this monograph had the privilege of examining herbarium material of the critical species of *Nania* in the herbaria of the Bureau of Science in Manila, P. I., and Botanic Garden of Buitenzorg in Java. He also saw living material of *Nania vera*, during the summer of 1916. He also was able to consult the original work of Rumph and other early works (with reference to *Metrosideros*) in the Libraries of the above mentioned institutions.

Through the kindness of Dr. L. B. Robinson of the Gray herbarium he was enabled to examine Asa Gray's types of *Metrosideros rugosa*, and varieties of *Metrosideros collina* subsp. *polymorpha* (previously known as *Metrosideros polymorpha* Gaud.) The writer had at his disposal for examination also specimens of *Metrosideros collina* (Forster) Gray from the South Sea Islands, as Fiji and Tahiti, as well as specimens from the Kermadec Islands. The writer is indebted to Dr. T. F. Cheeseman for specimens collected in the latter islands.

INTRODUCTION

During the years 1741 to 1755 there appeared a work by George Eberhard Rumph in six volumes entitled "*Herbarium Amboinense*."

His name has been latinized to Rumphius and his work is now usually quoted as Rumphius, *Herbarium Amboinense*.

It is in this work that the name *Metrosideros* appears for the first time. The genus *Metrosideros* was published in Book Four, (heft) pamphlet six, on page 19, and the first specimen described under *Metrosideros* is figured on table seven.*

Rumphius figures and describes under the name of *Metrosideros* other plants which belong to five different families. The first is *Metrosideros vera* on plate seven of which Rumphius remarks as follows:

"*Ramum exhibet at Litt. A. floriferum arboris, quae Metrosideros vera seu Nani vocatur.*

Observatio

Arbor-haec sub nomine *Nani* a Valent. in Aboinae descripsit page 220 occurrit et in Tab. sub no, LIII, exhibetur."†

Other specimens figured as *Metrosideros* by Rumphius are:

- T. 8 *Metrosideros macassarensis*
- " 9 *Nani hua*
- " 10 *Metrosideros Amboinensis*
- " 11 *Metrosideros molucca*
- " 12 *Metrosideri quae Samar femina vocatur*—?
(two pictures A and B.)
- " 13 *Metrosideros spuria*

None of the above cited plants belong to the family *Myrtaceae* to which his first species *Metrosideros vera* belongs.

In the year 1763 there appeared Michel Adanson's work *Familles des Plantes*. Adanson takes up the name *Nani* instead of *Metrosideros* and on page 88 in Volume II gives the following short description:—

"*Feuilles opp. fleurs, terminal corymbs. calyce 4 egales, corolle 4. Etamine 50. Fruit baye graines—plusieurs osselets dans chaque loge.*"

This is all Adanson has to say in regard to *Nani*; he gives no citation nor does he connect any definite plant with the name *Nani*. He evidently refers to *Nani*=*Metrosideros vera* as the description would indicate.

This name *Nani* was latinized by Frederic A. W. Miquel to *Nania* in his *Flora Indiae batavae* (1885, page 399, Part I.) Miquel gives the first proper description of the genus *Nania* (*Nani*) and cites the following specimen:—

Nania vera Miq. mss.—*Metrosideros vera* minor Rumph. Herb. Am. III. p. 16 t. 7 — *Syncarpia Vertholeni* Teysm. et Binnend. Natuurk. Tijdschr. Neerl. Ind. II, p. 307.

* Proper citation for *Metrosideros vera* is: Rumphius *Herbarium Amboinense* III: 19. t. 7. 1743.

† Translation: This tree is mentioned by Valent. in his description of Amboina and called by him *Nani Tree* and figured on plate 53.

Previous to Miquel's publication of *Nania vera* in his *Flora Indiae batavae*, J. E. Theysmann and S. Binnendijk published a paper entitled *Nieuwe Plantensorten in's Lands Plantentuin Te Buitenzorg*, in *Natuurkundig Tijdschrift voor Ned. Ind.* Vol. II: 307. 1851. In that paper appears a description of a plant under the name *Syncarpia Vertholeni* as follows:

Syncarpia Vertholeni nobis.

"This is the tree which is figured in Herbar. Amboin. by Rumphius, Vol. III, page 16, t. 7, and described under the name of *Metrosideros vera*."

He states further that young plants had been brought from Amboina to Buitenzorg where it fruited profusely; it became evident that it did not belong to *Metrosideros* which had been established by Banks, but to *Syncarpia*, etc.

The specific name *Vertholeni* was given in honor of Lieutenant Colonel Vertholen.

The name *Metrosideros vera* Rumph has however no validity as it is pre-Linnean (ante 1753).

John Lindley in his *Collectanea Botanica* or figures and botanical illustrations of rare and curious exotic plants, figures on plate 18 (1821) *Metrosideros vera* which is the legal publication of the specific name *vera*. The name *vera* was however not taken up by Theysmann and Binnendijk who substituted the name *Vertholeni* but the plant was placed by them in the genus *Syncarpia*, which was erroneous.

If the plant published on plate 18 by Lindley is really identical with Rumphius' *Metrosideros vera* and if the publication of a plate is sufficient to establish authorship, then the proper name for the plant in question is *Nania vera* (Lindley) Miquel. If the opposite is the case then the plant must bear the name *Nania Vertholeni* (Theysmann and Binnendijk) Rock. The genus *Nania* is not a synonym of *Metrosideros* but is a distinct genus as has been pointed out by Drs. Koorders and Valetton, who published a second species of *Nania*, *N. petiolata* and who consequently upheld *Nania vera* (Lindley) Miquel.

The capsule of *Nania* is—*4-loculare, loculicida demum tota libera, calyce recurvo suffulta*. (The capsule is four celled and entirely free from the recurved calyx.)

The writer has seen and examined abundant material of *Nania vera* as well as of *Nania petiolata* in the Herbarium of the Botanical Gardens at Buitenzorg in Java. He also examined a living tree of *Nania vera* in the above mentioned gardens and is of the same opinion as Drs. Koorders and Valetton. *Nania* is certainly generically distinct from *Metrosideros*, the habit also is not that of a true *Metrosideros*.

NOMENCLATURE OF THE GENUS **METROSIDEROS**, ITS HISTORY, AND THE TAXONOMY OF **METROSIDEROS COLLINA**
THE TYPE OF THE GENUS

Since the genus *Nania*, based on *Nania vera* must be eliminated from *Metrosideros* and recognized as a distinct genus of two species, the former and *Nania petiolata*, we must look for another species as the type of the genus *Metrosideros*.

The genus *Metrosideros* was established by Joseph Banks in Joseph Gaertner's *de Fructibus et seminibus plantarum* published in the first volume on page 170 and based on twelve species which are figured on table 34; the volume appeared in 1788. The twelve species are of Solander. Only four out of the twelve species are true *Metrosideros*; the remaining eight have been referred to other genera.

The status of the twelve species is as follows:

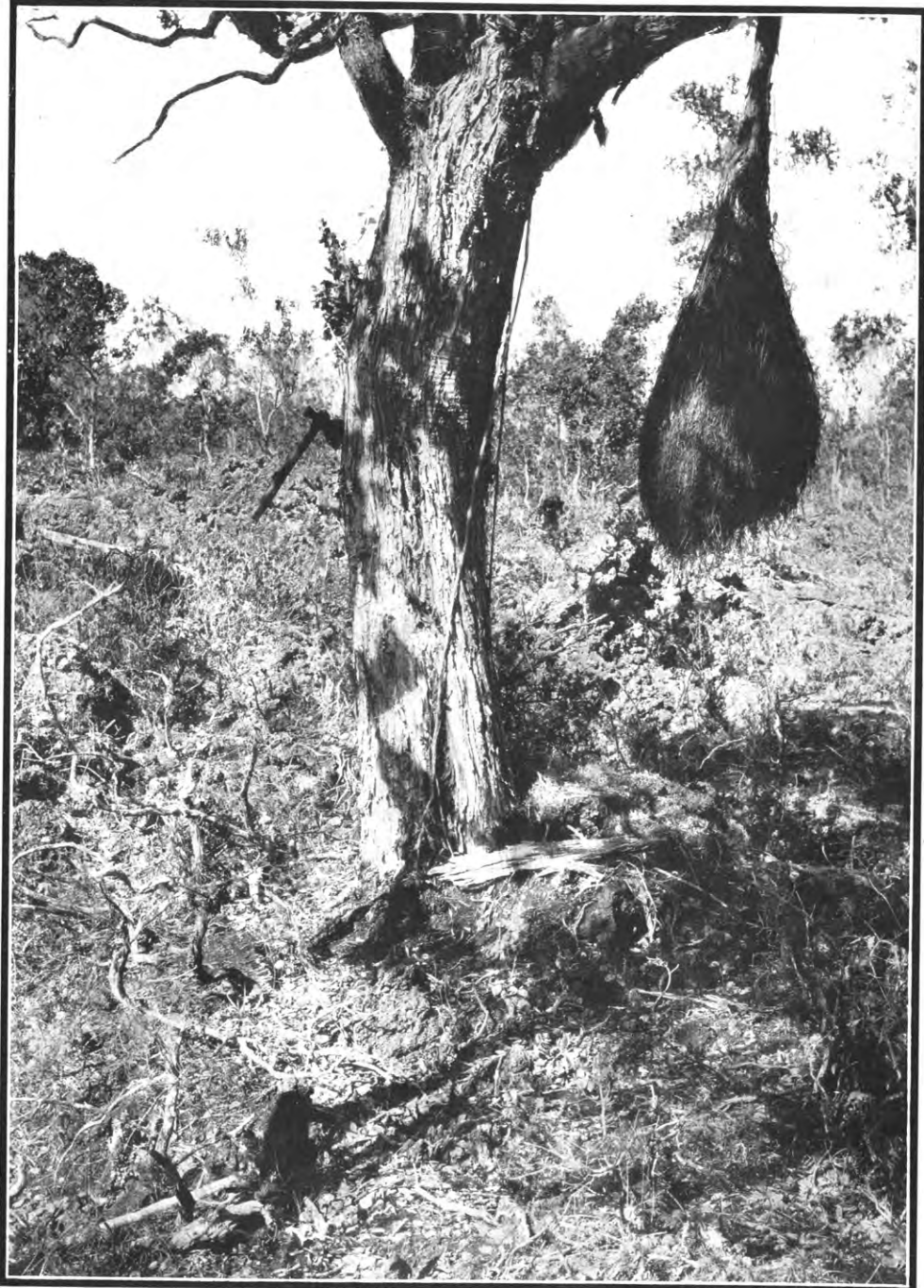
- 1 *Metrosideros gummifera* Sol.=*Eucalyptus gummifera* (Banks) Sm.=
Eucalyptus corymbosa teste Ind. Kew.
2. " *costata* Sol.=*Angophora lanceolata* Sm.
3. " *salicifolia* Sol.=*Eucalyptus* sp?
4. " *viminalis* Sol.=*Callistemon rigidus*
5. " *armillaris* Sol.=*Melaleuca armillaris*
6. " *nodosa* Sol.=*Melaleuca nodosa*
7. " *fulgens* Sol.=*Angophora lanceolata* Sm.
8. " *excelsa* Sol.=*Leptospermum* sp?
9. " *spectabilis* Sol. = *Leptospermum collinum* J. Forster =
Melaleuca villosa L. f.=*Melaleuca* sp? G. Forster=
Melaleuca aestuosa G. Forster=*Metrosideros villosa* (L.
f.) Smith=*Metrosideros collina* (Forster) Gray.
10. " *scandens* Sol.
- " *albiflora* Sol.
- " *myrtifolia* Sol.=*Metrosideros diffusa* (G. Forster) Smith.

Since the ninth species, *M. spectabilis* is the first true *Metrosideros* it is here adopted as the type of the genus. However the specific name *collinum* being the first valid specific name published in the combination with *Leptospermum* which is identical with No. nine of Banks and Solander, the proper combination is therefore *Metrosideros collina* (Forster) Gray U. S. E. E. 1854, and not *Metrosideros villosa* (L. f.) Smith Bot. Charact. 1797.

James Edward Smith in his "Botanical Characters of some plants of the natural order of Myrti" in the Transactions of the Linnean Society of London, Vol. III, 268, 1797, publishes an article on the existing confusion of the genus *Metrosideros* and in an effort to straighten out the species of Linnaeus the younger and George Forster, makes the following statement:

"That this is a most distinct natural genus from *Leptospermum* as above defined there can be no doubt, though some great botanists have united them. Sir Joseph Banks, however, and Dr. Solander were well aware of their difference, and characterized *Metrosideros* by its very long stamina. The stigma being simple and small, not

PLATE I.



Metrosideros tree (var. *incana*) showing large bunch of aerial roots.
Growing on the Lava flows of Kona, Hawaii.

capitate nor depressed scarcely dilated, I beg leave to propose as a very certain and constant mark of distinction. The habit, moreover, is totally different from *Leptospermum*, and agrees with that of *Melaleuca*; at least this is the case with such species as have alternate leaves and those with opposite ones have no resemblance to *Leptospermum*.

"The petals are concave, nearly sessile, deciduous, generally less colored than the stamina. The capsule has most generally 3 valves and as many cells rarely 4. I believe it might safely be defined trilocularis absolutely, but I mentioned the number four in deference to Gaertner, till I can determine and examine all his species, which are very obscure. His *gummifera* is an *Eucalyptus* and some of his others are very doubtful. The species of this genus, described as *Melaleuca* by the younger Linnaeus and Dr. George Forster, are also very much confused, these authors having mutually misunderstood each other so often, and formed their definitions so loosely that, with most of their original named specimens before me, I can hardly clear up every doubt; nor can I at present determine how many of Forster's species are among Gaertner's."

He then enumerates 13 species under *Metrosideros* of which however only four are true *Metrosideros*, the other nine being distributed among the genera *Angophora*, *Syncarpha*, *Callistemon* and *Kunzea*.

George Forster in his *Prodromus Florulae Insularum Australium* published in 1786, enumerates and describes 9 species of *Melaleuca* on page 38, as follows:

- Number 210—*Melaleuca scoparia*=*Leptospermum scoparium*
- Number 211—*Melaleuca virgata*=*Baeckea virgata*
- Number 212—*Melaleuca perforata*=*Metrosideros perforata*
- Number 213—*Melaleuca diffusa*=*Metrosideros diffusa*.
- Number 214—*Melaleuca florida*=*Metrosideros diffusa*
- Number 215—*Melaleuca aestuosa*, foliis oppositis ovatis, ovatisque venosis (subtrinervis), pedunculis cymosis terminalibus tomentosis.
F. *Leptospermum collinum* Forster *Charact. gen.* 36. No. 2=
Metrosideros collina (F.) Gray. *Melaleuca lucida*? M. S. V.
p. 699 No. 2 *Societatis insulae*
- Number 216—*Melaleuca lucida*=*Metrosideros lucida*
- Number 217—*Melaleuca ciliata*=*Metrosideros ciliata*
- Number 218—*Melaleuca Leucadendron*=*Melaleuca leucadendron*

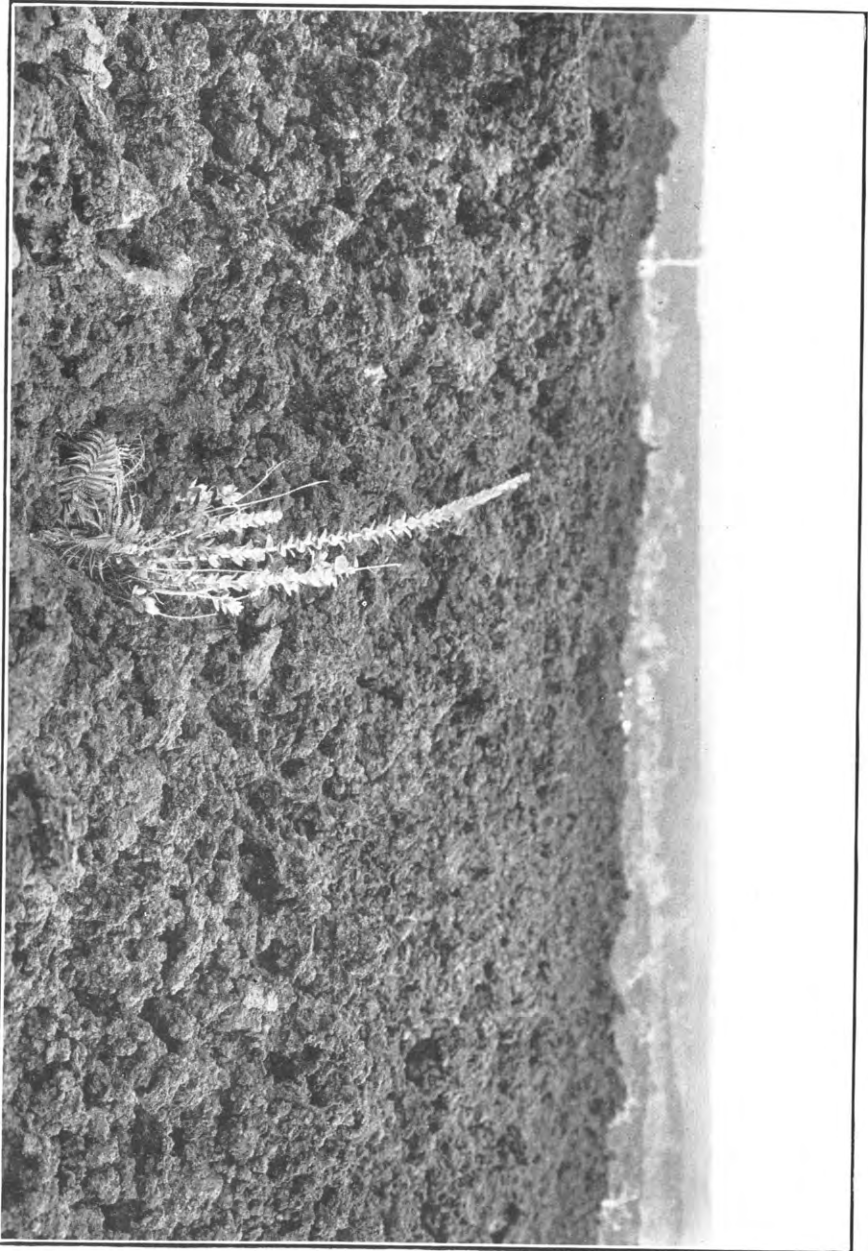
Of his nine species only one, as can be seen by the determination, is a true *Melaleuca*, six belong to *Metrosideros*. The *Index Kewensis* is very faulty in regard to the above mentioned species for example: *Index Kew II*, page 187, *Melaleuca florida* G. Forst. is quoted as a synonym of *Metrosideros diffusa* (G. Forst.) Smith; on page 221 *Metrosideros florida* (G. Forst.) Smith which is *Melaleuca florida* G. Forst. is upheld as a good species. It may be that George Forster united two distinct species under *Melaleuca florida*, but why is it not annotated by the usual "in part"?

Again, *Index Kew. II*, page 188, *Melaleuca villosa* L. f. 1781 is upheld as a good species from Tahiti, while on page 222 it is quoted as a synonym of *Metrosideros villosa* (L. f.) Smith, and on page 64 *Leptospermum collinum* F. 1776 is equal to *Metrosideros collina* (F.) Gray which is upheld as a good species, while on page 221 it is quoted as a synonym of *Metrosideros villosa* (L. f.) Sm.

Such citation can only lead to confusion.

The synonymy of *Metrosideros collina* (J. R. Forster) Asa Gray is as follows:

PLATE II.



Metrosideros collina (F.) A. Gray subsp. *polymorpha* (Grand.) var. *incana* (Levl.) growing epiphytically on *Sadleria cyathoides* on the 1907 aa lava flow. South Kona, Hawaii.

Metrosideros collina (Forster) Asa Gray, United States Exploring Expedition Vol. XIV: 558 t. 68. 1854.

Leptospermum collinum J. R. Forster Charact. gen. Plant. 72. 1776.

Melaleuca villosa Linn. f. Supplement 342. 1781.

Melaleuca aestuosa G. Forster Florul. Ins. Austr. Prodr. 38, No. 215. 1786.

Melaleuca sp.? G. Forster. 1786.

Metrosideros spectabilis Banks et Solander ex Gaertner de Fruct. Semin. Plant. Vol. I. 170, t. 34. 1788.

Metrosideros villosa (L. f.) Smith Transact. Linn. Soc. Vol. III:268. 1797.

Charles Gaudichaud-Beaupré, the Botanist of the "*Voyage autour du monde sur la corvette l'Uranie*," published in the year 1826 a *Metrosideros polymorpha* from the Hawaiian Islands, remarking in the introduction on page 99 of the above cited publication: "Rien au monde, en effet, n'est plus remarquable que le *metrosideros polymorpha*, à feuilles linéaires vers le sommet de la montagne, successivement linéaires — lancéolées, lancéolées ovales, obovales, elliptiques, arrondis, meme cordiformes, a mesure qu'on en descend, et qui, de glabres et luisantes qu'elles étoient primitivement, devient pubescentes, velues, et de plus en plus tomenteuse."

Asa Gray, who worked up the material collected by the U. S. Exploring Expedition under Capt. Wilkes, established in Volume 14 of the U. S. E. E., 1854, page 558, for the first time the proper combination using the oldest name *collinum* of Forster, *Metrosideros collina* (Forster) Asa Gray, at the same time establishing three varieties of the latter, var. *a villosa* citing *Melaleuca villosa*, *Metrosideros spectabilis* and *Metrosideros villosa* Smith, as synonyms; var. *β glaberrima* citing *Metrosideros villosa* var. *glaberrima* Bertero ex Guill. Zeph. Tait. page 57, and *Metrosideros diffusa* Hooker et Arnott as synonyms, and a variety *γ vitiensis* v. n.

He further remarks: "The *M. villosa* of Smith with the young leaves, branchlets and especially the inflorescence canescent with a villous-tomentose down, passes so completely into glabrate and truly glabrous forms that it becomes advisable to restore the earliest specific name, that of the elder Forster."

Asa Gray, however, recognizes also *Metrosideros polymorpha* of Gaudichaud mainly on the strength of the pedicellate flowers, while those of *M. collina* are sessile, or, as he remarks himself, "nearly so." From the specimens in the Gray Herbarium, which were kindly put at my disposal as a loan through the courtesy of Dr. B. L. Robinson of Harvard, I could see that the pedicellate flowers as a specific distinction between *M. collina* and *M. polymorpha* are untenable. For in the various specimens of *M. collina* from Tahiti, Fiji and Society Islands, there are sessile as well as pedicellate flowers noticeable, in fact, in some specimens, the pedicels were even longer than occur in *M. polymorpha*. Hillebrand himself, in his "Flora of the Hawaiian Islands," remarks in a footnote: "Having already convinced myself from an examination in the Gray Herbarium that forms of *M. collina* from the Society and Viti groups were in no particular distinguishable from var. ζ^* of the Hawaiian *M. polymorpha*, I

* Now: *Metrosideros tremuloides* (Heller) Knuth.

PLATE III.



A tall *metrosideros* tree with stilt roots, caused by germinating and beginning life at the top of a tree fern. Remnants of the supporting fern can still be seen in the middle of the trunk. The prevailing type in the rain forest near Glenwood, Hawaii.

readily adopt the view of B. Seeman, who, after a review of the larger material preserved in the British Museum, comes to the conclusion that all the *Metrosideros* of those groups belong to the Hawaiian polymorphous species." It would be convenient indeed, if the specific name *polymorpha* could be retained, were it not for the laws of nomenclature and priority, which force us to accept the earliest name which is Forster's *collina*. But owing to the very few variations occurring in the species *collina* in the South Sea Islands, and the large number of varieties and forms found in the Hawaiian Islands, which in themselves vary again tremendously, the writer was prompted to adopt for the Hawaiian forms the specific name *polymorpha*, of Gaudichaud, as a subspecific one of *Metrosideros collina* (Forster) A. Gray. This is done for two main reasons, first, to designate the Hawaiian forms; and second, to avoid too much confusion in nomenclature and synonymy.

The writer was loath to establish this trinominal system for our Hawaiian *Metrosideros*, but found that it is the least objectionable, for reasons above stated.

Outside the four endemic species of *Metrosideros*, all the remaining varieties and forms treated in this paper must then be referred to *Metrosideros collina* (J. R. Forster) A. Gray, subspecies *polymorpha* (Gaudichaud) Rock.

Nieden zu* quotes Forster as the author of *Metrosideros polymorpha* instead of Gaudichaud; how he came to commit this error is difficult to see, since Forster has never been quoted as author of *M. polymorpha*, save by T. Kirk in his "Forest Flora of New Zealand," which gives Forster as the author of *polymorpha*, but does not cite the bibliography, or on what authority he based his combination.

POSITION OF THE GENUS METROSIDEROS, ITS SECTIONS AND SPECIES ACCORDING TO OUR PRESENT KNOWLEDGE

Nieden zu, in his treatment on the Myrtaceae in Engler and Prantl,* places the genus *Metrosideros* Banks, at the head of the section *Leptospermoideae; Metrosiderineae*. According to Nieden zu a species of plant possessing the following characters, is referable to the genus *Metrosideros*:

"Corolla perigynous. Receptaculum turbinate, campanulate or urceolate. Calyx lobes 5, broad, obtuse. Corolla lobes 5, rounded. Stamens many, usually in one row; filaments free, long; anthers elongate, dorsifixed, versatil, with longitudinal cells; connective with glandular point. Ovary united with the receptaculum at the base, three-celled; style very long; stigma simple. Placenta axile; ovules covering the whole placenta, ascending. Seeds many only partly fertile; testa thin; embryo straight; cotyledons flat or folded, longer than hypocotyle. Trees or shrubs, rarely climbers. Leaves opposite. Flowers in terminal—rarely axillary cymes."

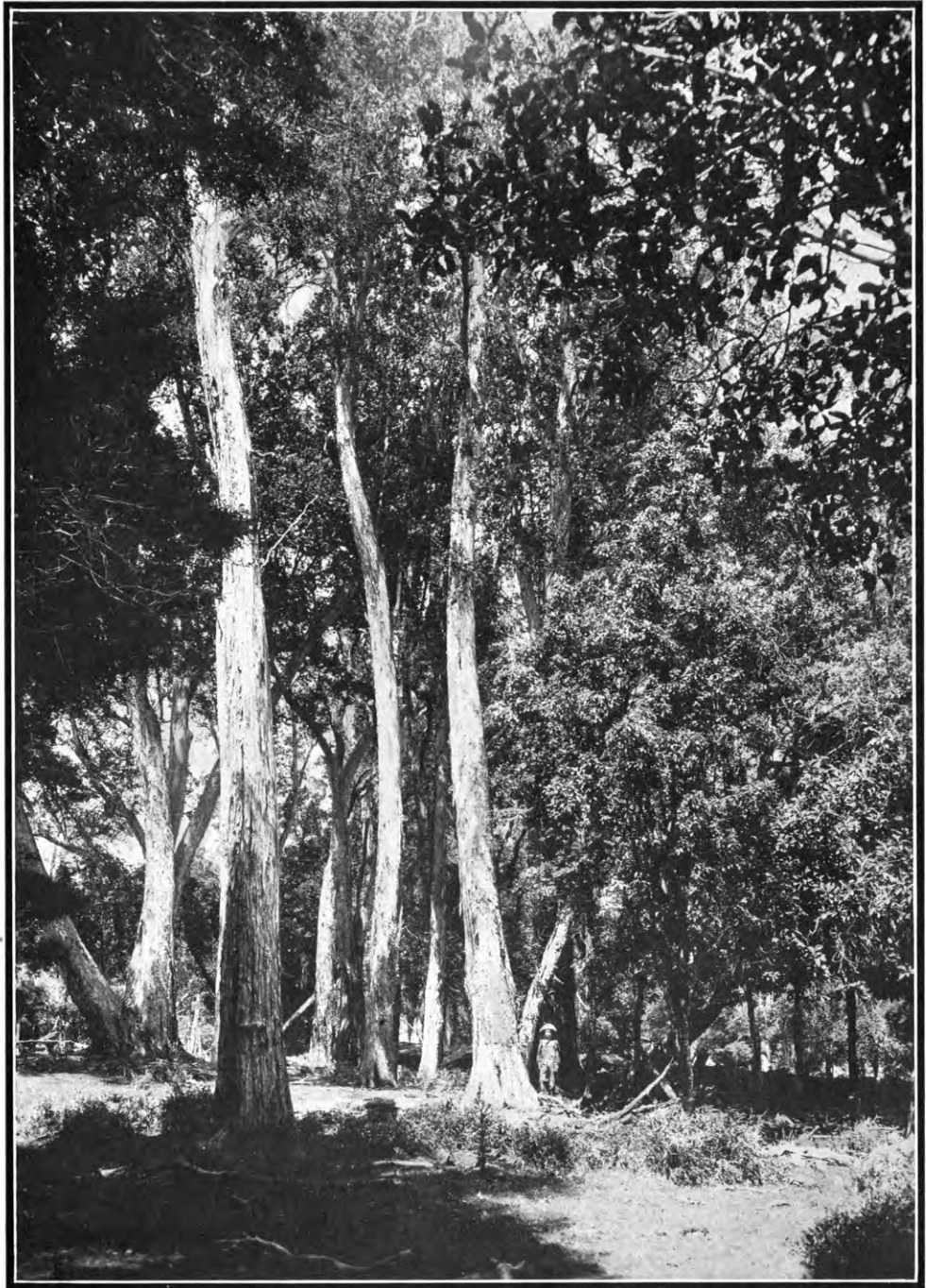
He divides the genus into two sections based on the shape of the seeds, as follows:

Section one:—*Eumetrosideros* Ndz. Seeds linear.

Section two:—*Nania* Miq. Seeds flattened.

* Engler and Prantl *Natürliche Pflanzenfam.* III: 7. 87. 1893.

PLATE IV.



Metrosideros collina polymorpha var incana.

A grove of mature trees in the Kipuka Puaulu, near the Volcano of Kilauea, on Hawaii. The trees are over 80 feet in height, some of them nearly a hundred feet.

The first section is divided into two groups: *A*—capsule exerted from the receptaculum, and *B*—capsule enclosed in the receptaculum.

This seems to be untenable, as we find capsules both enclosed and exerted, in the numerous varieties and forms of *M. collina* (F.) Gray subsp. *polymorpha* (Gaud.); thus eliminating it as a key for the species. Section two is eliminated entirely as it embraces *Nania vera* which is not referable to *Metrosideros*.

Characters for specific distinction

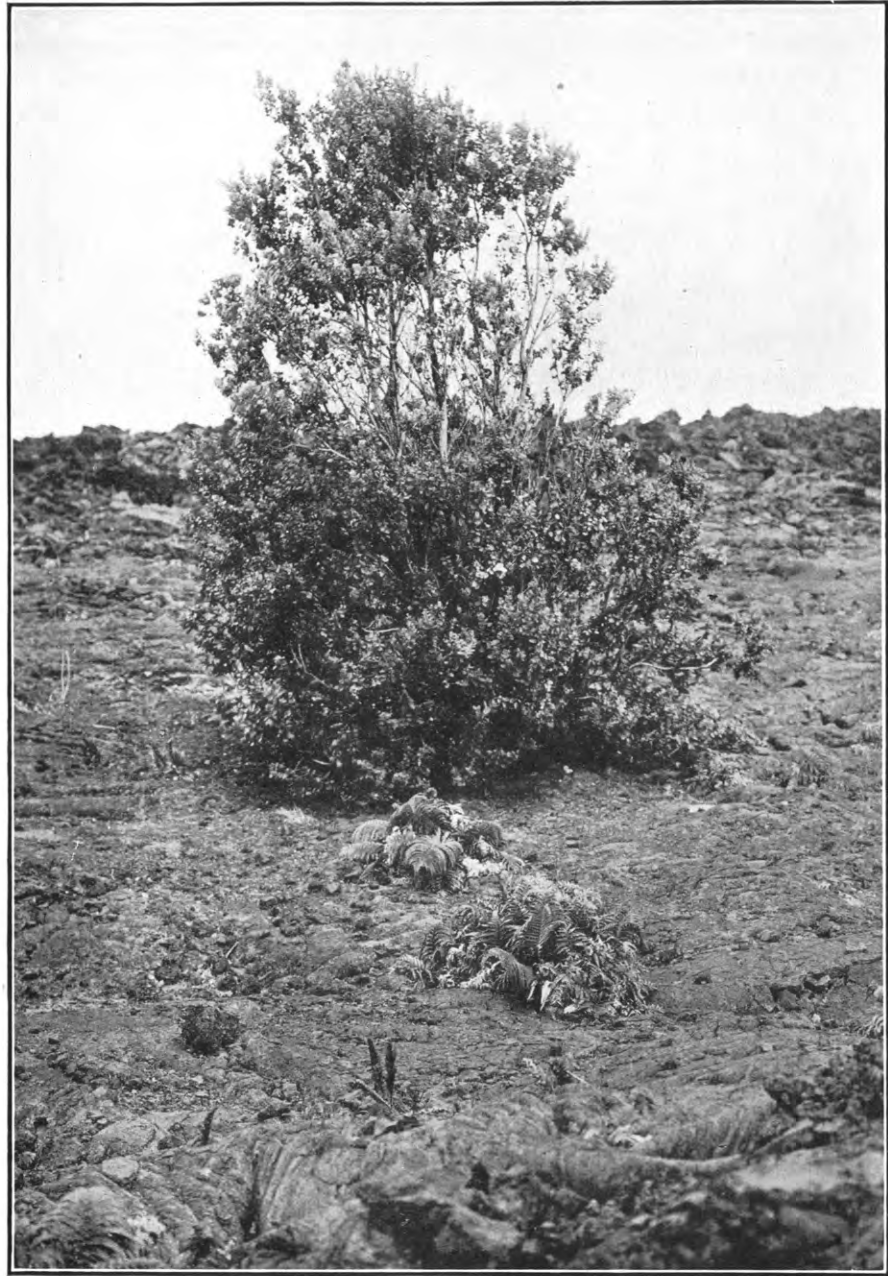
As already remarked in the previous chapter, Niedenzu's key based on the enclosed and exerted capsules is untenable, as such characters occur in the varieties and forms of one species. It is difficult indeed to designate real and sound specific characters, at least as far as the Hawaiian species are concerned, for strictly speaking there is but one real good species to be found in these islands outside *M. collina* subsp. *polymorpha*, and that is *M. macropus* H. et A. While *M. rugosa*, *M. tremuloides*, and *M. Waialealae* are certainly different from *M. collina* when seen growing in the field, they appear, after close investigation, to be nothing else than ancient satellites of *M. collina*, and perhaps referable to that species. They are indeed very old varieties at least, for they are constant and quite distinct and show no such gradation in leaf characters as are found in varieties and even forms of *M. collina* subsp. *polymorpha*. Var. *incana*, for example, displaying not less than fourteen different grades, all referable to this one variety, while forma *sericea* of the var. *glaberrima* displays six different gradations, and the variety proper, seven and even more, for there are still others which must be referred to this variety and form. The writer thought it advisable to uphold the specific rank of the three otherwise doubtful species on the fact that their characters are constant, and that they, themselves, are confined to one island, not having been found on more than one, and at that are restricted to a very circumscribed locality.

M. Macropus is the most distinct of all of the Hawaiian species, and is distinguishable by its very long petioled leaves and the open but densely bracteate and bracteolate cyme.

M. tremuloides is distinguished by its very slender graceful foliage, and drooping flexible branchlets; closely related to it is *M. Waialealae*, which as the specific name implies, inhabits the high swampy plateau of Kauai, Mt. Waialeale, 5000 feet, where it is a handsome tree, perfectly glabrous in all parts, its leaves are of a pale green with red midrib and veins, are long petioled, and caudately acuminate.

M. rugosa inhabits only the open, exposed cliffs on the very crest of the main back-bone of the Island of Oahu, overlooking the windward side. It is distinguished by its thick, coriaceous, deeply rugose leaves, which are dark green above and densely woolly underneath. It is nearly always a shrub, very seldom becoming a small tree 10-15 feet in height.

In separating the numerous varieties and forms of *Metrosideros collina* subspecies *polymorpha*, the following characters have been selected: First the writer adopted Gaudichaud's type of *M. polymorpha*, as figured in Plate 108 in the Atlas of the Botany Voyage Uranie, as the typical form, accepting Gaudichaud's name *polymorpha* as a subspecific name in order to designate the



Metrosideros collina (F.) A. Gray subsp. **polymorpha** (Gaud.)
var. **incana** (Levl.) growing on the 1868 pahoehoe (smooth)
lava flow. It started life in all probability on such **Sadleria**
ferns as are seen in the foreground.

Hawaiian varieties of *M. collina*, and making Gaudichaud's type the var. *a typica*. Var. *imbricata* which occurs only on Oahu, differs from *a typica* in the thinner leaves, which are subsessile and imbricately arranged on the branches; some authors say that this may be due to dry seasons, when growth has been checked. This is very questionable for the plate shows three specimens collected at intervals of two or even three decades, and the characteristic imbrication is present in all three specimens. Besides specimens collected by the writer fifty years after the last specimen collected by Seeman (the middle figure on Plate XVII), show the same characteristics.

The other characters which served for the separating of varieties are as follows: 1. Leaves densely tomentose, as well as inflorescence. 2. Leaves small thick, ovate, subsessile, perfectly glabrous, but woolly inflorescence. 3. Leaves very large, fleshy ovate-oblong petiolate, glabrous, inflorescence tomentose. 4. Leaves smaller, linear-oblong, perfectly glabrous, woolly inflorescence. 5. Plant a bush 3 feet high, with ovate glabrous leaves acute at both ends, inflorescence woolly. 6. Leaves very small, cordate, plant small prostrate only a few inches long, inflorescence woolly. 7. Leaves linear, almost lanceolate, glabrous, inflorescence pruinose. 8. Leaves and inflorescence perfectly glabrous.

While the writer does not at all claim the present arrangement or key to these varieties to be the last word, it nevertheless places these varieties and their forms according to their relationship to one another. Hybridization has probably been the main factor, next to location and environment, in producing these varieties. While a number of them are constant, others embrace a host of variations, which, if one were to undertake to name, would mean the naming of each individual tree he comes across.

Phylogeny of the Hawaiian *Metrosideros*

It is difficult indeed to point to a certain species as ancestor of the Hawaiian *Metrosideros*. It may be assumed, however, that all the species of *Metrosideros* known outside of these Islands, were not evolved from species occurring in the Hawaiian Islands, but that exactly the reverse is the case.

Metrosideros collina (Forster) A. Gray, which is so widely distributed over the South Pacific Islands, must undoubtedly have originated in that region, perhaps was evolved from some of the monotypic genera still existing in South America, so rich in *Myrtaceae*. Nowhere in the South Pacific Islands has *Metrosideros collina* split into so numerous varieties and forms as in the Hawaiian Islands. The typical *Metrosideros collina* of Fiji is identical with specimens of the same species from Tahiti and the Kermadec Islands, while in Hawaii there is not one variety of which it could be said with the same accuracy, that it is absolutely identical with the typical *M. collina*, of the South Seas, however close to and inseparable it may be from the typical *M. collina*. This fact resolved the writer to adopt the old specific name *polymorpha* as subspecies name. The Hawaiian var. *incana* is the nearest to the typical *M. collina* of Tahiti and Fiji, while the Hawaiian var. *glaberrima* forma *sericea* is almost identical with Asa Gray's var. γ *vitiensis* from Fiji.

In none of the South Sea forms do we find as long petiolate leaves as in the Hawaiian forms, which fact may be due to the infusion of blood from the very distinct species *M. macropus* H. et A. peculiar to Oahu (?). The presence of

PLATE VI.



Typical Tree-fern forest at Kilauea, Hawaii; the forest is of the younger type and is composed mainly of *Cibotium Chammissoi*, *C. Menziesii* and *Metrosideros collina polymorpha* var. *incana*.

this species and the numerous types of topography, as from sea level to almost perpetual snow, and the influence of climatic differences, are the probable factors responsible for the numerous varieties.

The characters which we now recognize as attributable to the genus *Metrosideros*, were undoubtedly established on the old island of New Zealand, which became the center of distribution after the emergence of the islands of the South and North Pacific. New Zealand possesses the largest number of endemic species, from large trees to actual lianas or climbers. *Metrosideros collina* is also present in New Zealand, but is absent from Norfolk Island and from Australia. As far as the colony of New Zealand is concerned, it is confined to Sunday Island, one of the Kermadec group.

That *Metrosideros collina*, which developed into the subspecies *polymorpha*, due to facts already stated, is a comparatively speaking new arrival in the Hawaiian group, of course by far antedating the arrival of the race which we call Hawaiians, is well illustrated by its distribution on the large island Hawaii, where it forms almost pure stands over large tracts of land. There it is the prevailing tree, while on the much older islands as Kauai, Oahu and Molokai, it occurs never in pure stands, but always as individuals, which increase in number wherever man has disturbed conditions, as in the outskirts of the forest on the lee side of Kauai, where vegetation, which is less able to quickly establish itself again, is kept down by the upgrowth of *Metrosideros*. Were *Metrosideros collina* as old an inhabitant as some of the other Hawaiian trees, for example the *Kalia*, *Elaeocarpus bifidus*, which takes the places of *Metrosideros collina* in the middle forest region on Kauai, it would certainly cover the older islands to the same extent as it covers the large island Hawaii today. For if any tree can adapt itself to almost any condition and environment, it is the *Ohia Lehua*, *Metrosideros collina polymorpha*.

The Hawaiian *Metrosideros collina polymorpha*, especially the varieties occurring on the Island of Hawaii, develop often large bunches of aerial roots, not only in dry regions where only a xerophytic vegetation can thrive, but also in the most humid rain forests. This proves that the developing of aerial roots is not for assimilating purposes, such as for taking up moisture from the air, etc., but that their presence is due to a law of heredity, the reverting to, or the producing of certain characters peculiar to the ancestor. This ancestor may be found in some of the climbing species of New Zealand, probably the oldest forms in the genus *Metrosideros*. Mr. Chesebrough informs the writer that the *Metrosideros robusta* of New Zealand develops huge aerial roots, which coalesce and form large trunks. Such aerial roots as occur in *Metrosideros robusta* seem not to be the same as those referred to, for Mr. Chesebrough says in his "Flora of New Zealand": "It usually begins life as an epiphyte in the upper branches of some tall forest tree, sending to the ground aerial roots which coalesce and form a trunk after the death of the supporting plant." Exactly the same happens with our subspecies *polymorpha*, which even commences life as an epiphyte on the arid lava flows on small ferns, which always precede a stand of *Ohia* trees on newer lava flows.

The aerial roots the writer refers to do not, at least he has been unable to observe it, coalesce and form trunks, but grow out of the upper branches of often very tall trees, and have the aspect of a huge weaver-bird's nest.



Typical *Metrosideros* forest, the prevailing type is the variety *incana*. *Cibotium* ferns in foreground.

The Hawaiian *Metrosideros*, at least *M. collina polymorpha*, begins life as an epiphyte even on new lava flows, as the accompanying plate illustrates. (On the 1907 flow on the slopes of Mauna Loa, the first Ohia lehua beginning life as an epiphyte on *Sadleria cyathoides*, the *Amau* fern.) In the somber forests it begins life more often on *Cibotium menziesii* and *Cibotium chamissoi*, the *Hapu iii* and *Hapu* tree ferns, respectively, than as a terrestrial. What happens in New Zealand with *M. robusta* repeats itself with *M. collina polymorpha*, especially the var. *incana*, only that the supporter in Hawaii succumbs more quickly than the big tree in New Zealand; as the tree fern is of much smaller stature the Ohia lehua cannot develop such huge trunks as the New Zealand *Rata*.

Distribution of the genus *Metrosideros*

As has been stated in the previous chapter, the home of the genus *Metrosideros* is probably to be found in New Zealand; for the largest number of endemic species occur there.

In the latest work on the "Flora of New Zealand" Cheeseman enumerates and describes eleven species, ten of which are endemic, while one is distributed all over Polynesia. Of the ten endemic species, four are actual climbers, while two are climbing shrubs, one a much branched shrub with straggling, often prostrate branches, and the remaining three, trees reaching a height of from 30-60, or in one case (*M. robusta*) even 100 feet. In the Polynesian Islands the genus is represented by *Metrosideros collina*, extending from the Kermadec Islands to Hawaii, where it is represented by the subspecies *polymorpha*, over a latitude of from about 30° South to 22° North. One species, *M. angustifolia*, is peculiar to South Africa.

Metrosideros lucida extends the farthest south of any, reaching a latitude of 52° S. in Auckland Island, where it is abundant from sea level to an elevation of 500 feet, skirting the eastern shore with a broad belt of forest; it reaches a height of 20-40 feet, with a trunk of 2-3 feet in diameter.

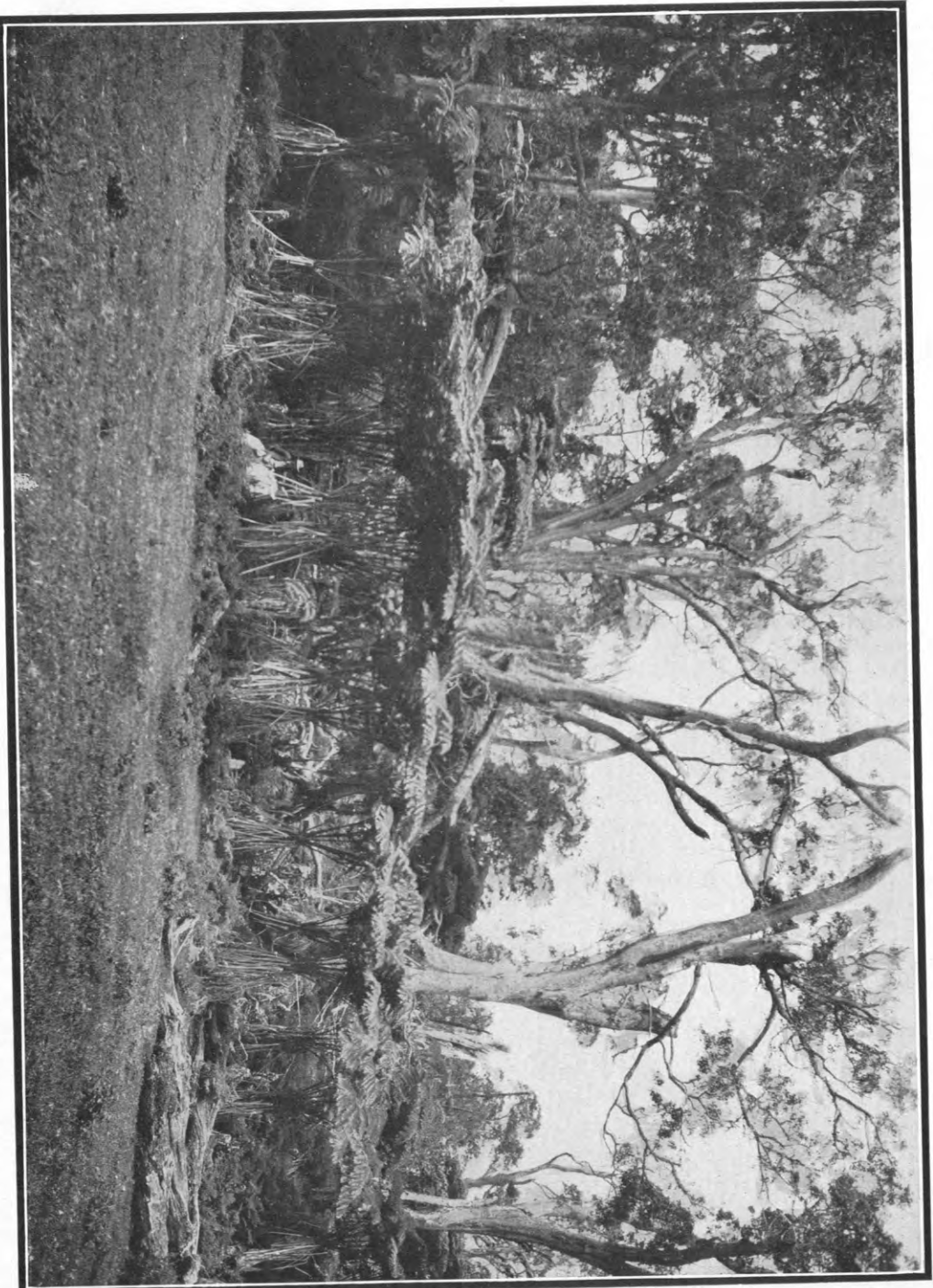
In the Hawaiian Islands the genus is represented, next to the common *M. collina polymorpha* with its many varieties, by four species, one of which is very distinct, while the three others are more or less intimately connected with *M. collina polymorpha*. In North Australia we find a lone species of *Metrosideros*, *M. eucalyptoides*, growing in arid regions, and in New Caledonia several species peculiar to that island.

Distribution of *Metrosideros collina* (Forst.) A. Gray.

Metrosideros collina is the only species of the genus which enjoys a distribution covering a latitude from about 30° S. to 22° N. Its southernmost station is on Raoul or Sunday Island of the Kermadec group, latitude 29° 20' S., where it can be found from sea level to the summit of the island, 1627 feet elevation. According to Chesemann it is the most abundant tree.

In the Society Islands it has been collected on Tahiti where it grows from practically sea level to 3600 feet elevation, and on Eimeo Island of the same group, extending from there to the Marquesas Islands, where it was collected on Noukahiva by Dupetit-Thouars, Mercier, Hombran and Jardin; and to Mangareva of the Paumotu Archipelago.

In Rarotonga, the chief island of the Cook group, it is abundant on all the hills ascending to the tops of the highest peaks, altitude 2200 feet. Chesemann



Fern and *Metrosideros* forest back of the Shipman Ranch on the trail to Punu Oo. The trees are var. *incana* of *Metrosideros*, the ferns *Cibotium Menziesii* and *C. Chamissoi*.

states that the tomentose form is much more plentiful than a nearly glabrous form with broader leaves.

In the Fiji or Viti Islands it is not uncommon on the Islands of Ovolau and Muthuata from an elevation of 100 to 2000 feet. In Samoa it has been observed by Reinecke on Tutuila at an elevation of 2000 feet. New Caledonia seems to be the western limit of its distribution, being found in about 166° E. Long., and Mangarewa, its easternmost at about 134° W. Long.

Its northernmost limit is reached in the Hawaiian group, where it is represented by the subspecies *polymorpha* with numerous varieties and forms, the distribution of which over the group proper is described in the following chapter.

DISTRIBUTION OF THE SPECIES AND VARIETIES OF METROSIDEROS IN THE HAWAIIAN ISLANDS

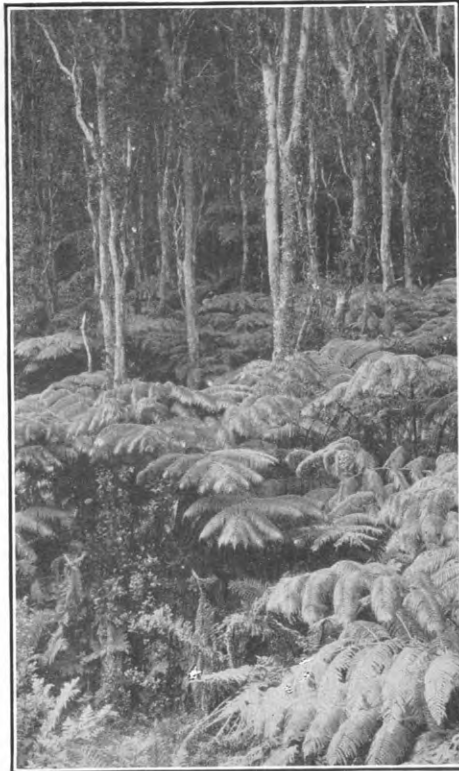
Besides the many varieties and forms of *M. collina polymorpha* which are more or less widely distributed over the whole group, there are four species which are rather local, that is they occur only in circumscribed localities. This, however, may be also said of certain varieties of *M. collina polymorpha*, and thus the question arises if three of the four species, which, like certain varieties of the species above mentioned, are constant, should not be referred to *M. collina polymorpha*, as has been done by earlier systematists. Certain points arise, however, which bear investigation, for example:

Metrosideros waialealae and *Metrosideros collina polymorpha* var. *prostrata*.

Both of these plants occur in the bog on the summit of Mt. Waialeale on Kauai, at an elevation of 5200 feet. The former species, a very handsome, if not the finest species of *Metrosideros* in these Islands, is a tree 25 feet in height, while only a few yards from it grows another *Metrosideros* referable to *M. collina polymorpha*, which, as the varietal name (*prostrata*) indicates, is a little creeping plant a foot or so in length. This same variety occurs on West Maui and Molokai, and a form of it in the bogs of the Kohala Mountains on Hawaii. *M. waialealae*, however, is peculiar to Mt. Waialeale on Kauai and while in its outward aspect quite different from *M. collina polymorpha* is, when closely examined, referable to the very glabrous varieties of that species; nevertheless, the caudately acuminate and long petioled leaves and very large flowers and fruits seem to justify its being raised to specific rank. Its specific value seems to be strengthened by the fact that when *M. collina polymorpha* encroaches on the various bogs of the Islands, it always becomes a creeper, while *M. waialealae* is a tree.

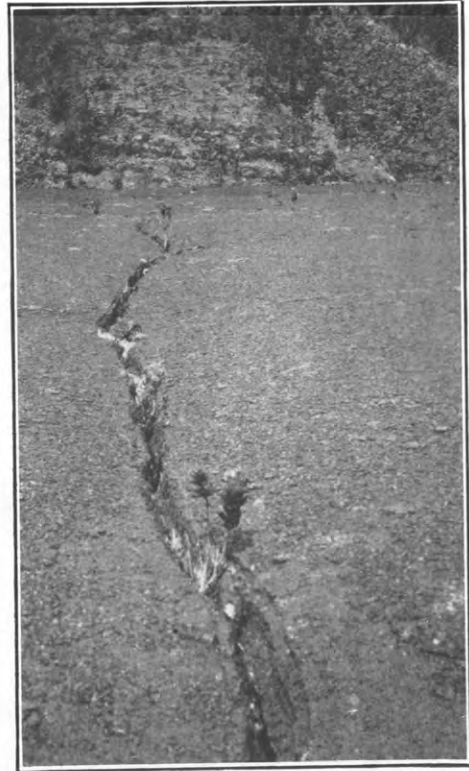
The second somewhat doubtful species is *M. tremuloides*; this, too, would come under the small leaved, glabrous varieties of *M. collina polymorpha*. Its outward aspect, the very slender graceful foliage and slender drooping branches and branchlets, distinguish this tree at once from all other species or varieties of *M. collina polymorpha*. It is confined to the Island of Oahu, occurring on the main range, especially at the lower elevations up to 2000 feet, mainly in the valleys, as in Kalihi, Nuuanu, Pauoa, Manoa, Palolo, and Niu. It usually grows by itself, but can often be found in company with var. *a* *typica* of *M. collina polymorpha*, and also var. *glaberrima*. Other writers, enlarging the characters of this species, have recorded it from other islands, but these types must be referred to varieties of *M. collina polymorpha*.

a



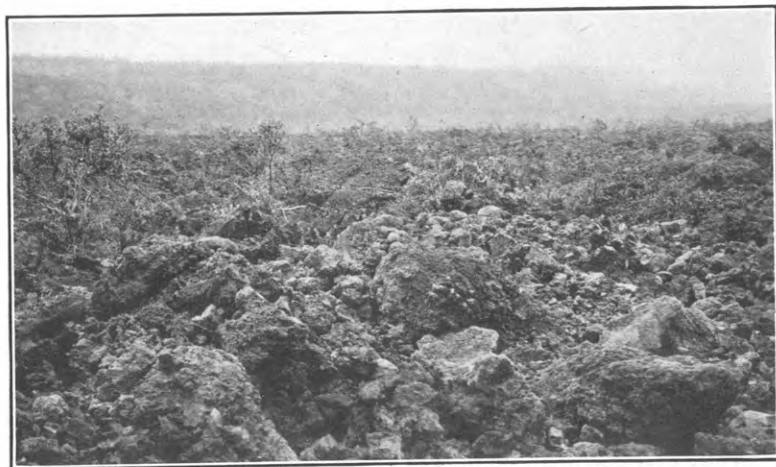
Pure stand of *Metrosideros collina polymorpha* var. *incana* along the road to the Volcano Kilauea. *Cibotium Menziesii* and *C. Chamissoi* form the main undergrowth.

b



Metrosideros collina polymorpha var. *incana* starting life in the cracks of the solid (pahoehoe) smooth lava floor of the crater Keanakakoi on Hawaii.

c



Metrosideros collina polymorpha var. *incana* growing on the 1823 aa rough lava flow along the Kau Road, Hawaii.

The third is a small tree usually stunted and as its name implies, quite rugose. *M. rugosa* established by Gray, was also classified with varieties of *M. Polymorpha*=*M. collina polymorpha*. Its very deeply rugose, woolly leaves and yellow scales and buds, and the gnarled habit of the small tree distinguishes it from the other *Ohia lehuas*, which, as Heller remarks, were even recognized by the Hawaiians, who were good botanists in their way, and gave them all specific names. This species for instance, they knew under the name of *Lehua papa*. It occurs only on the Island of Oahu, and that mainly on the very crest of the main range overlooking the windswept palis or cliffs on the windward side of the Island. It is a small tree or shrub, growing in company with *Coreopsis* and *Dubautia*, both composites, *Lobelia* and *Trematolobelia*, as well as with sedges, as *Cladium Meyenii* and *Cl. angustifolium*. It does occur, however, as a small tree 15 feet high, but still on exposed windswept locations in the mountains of Punaluu. It comes close to the form of a typical of *M. collina polymorpha*, found on Oahu, with which it is occasionally confused by the layman, but the difference is quite apparent when the two plants are placed side by side.

When one compares the three aforementioned species with one another, one cannot but come to the conclusion that they represent three distinct species, but when they are being compared with certain varieties of *M. collina polymorpha*, then they seem to lose their specific values to some extent, and seem to fit more or less into certain groups, notwithstanding existing gaps.

When discussing the distribution of the varieties, the matter becomes a good deal more difficult. It is not an easy matter to visit every locality on all the islands of the group, so what is stated here in the following lines is not to be taken as the actual limits of distribution, but simply records of location where certain varieties occur on the Island of Hawaii, we will begin with that Island, and simply mention the locations of the other varieties found on the other islands later on. The same variety may occur on the most varied topography, the actual characteristics which constitute the particular variety remain the same, or are perhaps slightly modified, but the habit of the plant is quite altered. For example: var. *incana* occurs along the Waiakea River, and on the grassy slopes down to the sea; on the bluffs of the stream it is stunted, in fact at that elevation it is never taller than 6-10 feet, while the same variety in the forests of Puna and in the Kipuka Puauu near the Volcano of Kilauea, is a tree of nearly 100 feet in height (See plate IV), while again on pahoehoe lava flows it is a small tree 30-40 feet in height starting as a shrub with branches down to the ground, (see plate V). In fact, var. *incana* is the commonest variety of *Metrosideros collina polymorpha*; it is practically the only one which occurs in pure stands together with tree ferns. It favors the newer lava flows where it begins life as an epiphyte on smaller ferns, it takes possession of the tree fern forests, starting life again as an epiphyte, the tree fern being the supporting plant, which later succumbs as the tree gains dimensions; this accounts for the many stilt roots of *Ohia lehuas*. (See plate III.)

The amount of seed produced by a single *Ohia* tree is enormous and as it is feather light, is blown by the wind over the vast open areas, mainly lava flows intersecting forest belts, where they lodge themselves in the woolly scales of ferns, which, owing to their fine spores, are the first to establish themselves. Later on when a stand of *Ohia* has succeeded the smaller ferns, and the resulting

PLATE X.

a



Vault, pahoehoe or smooth lava with little soil, occupied by *Metrosideros collina polymorpha* var. *incana*, on the slopes of Mauna Loa, elevation 5000-6000 feet.

b



Metrosideros collina polymorpha var. *incana* growing along dry watercourse in the ash fields of the Kau desert on Hawaii.

shade and development of humus due to the disintegration of the lava caused by its being broken up by the strong roots of the Ohias, admitting moisture, and leaf mould, the tree ferns then appear on the scene; after they have established themselves, the succeeding generations of Ohias begin their life on the larger tree ferns, thus building up larger, that is taller, forest trees. (See plates VI, VII, and VIII.)

This may be simply a step towards the upbuilding of another type of forest as can be seen in the older regions near the Volcano of Kīlauea. The disintegration of the tree fern trunks, the accumulation of humus and the birds acting as the agent of distribution, the ground having been prepared, the frugiferous birds finding shelter in the forests bring with them in their crops or stomachs fleshy seeds of trees such as *Antidesma*, *Ilex*, *Cheirodendron*, *Broussaisia* and others; these find a ground ready to receive them and a second type of forest of a more mesophytic nature develops. If left to itself, undisturbed for centuries, forest types develop, such as we find in the mountains of Kohala. This may be only attributable to Hawaii, for *Metrosideros* is a late arrival in this group, as compared with the much older trees found on the other islands which have, however, spread over Hawaii to a certain extent in certain regions, which were ready to receive them. The variety *Newellii* is also very common on Hawaii, but mainly in the vicinity of Hilo along the Waiakea River, and on the lava flow beyond. It is seldom a big tree, more often a shrub. Var. *macrophylla* is confined to the very wet forests in the neighborhood of Mountainview, and near Glenwood; it favors the rainbelt at an elevation of 2000 feet. The var. *a typica* occurs also on Hawaii, and is especially common at the Volcano of Kīlauea, growing in company with var. *incana*, which it resembles greatly, and is often only with difficulty distinguished. It inhabits also the forests of Oahu, back of Honolulu, where it becomes a good sized tree.

The var. *imbricata* is only found on Oahu in the mountains and valleys of the windward side at lower elevations.

The very distinct variety *Haleakalensis*, as the name implies, is found on the upper slopes of Mt. Haleakala, Maui, in the gulches of the crater of Puunianiau, in company with *Raillardia*, *Santalum*, *Styphelia*, etc.

The varieties *pumila* and *glabrifolia* both inhabit the Island of Kauai, the former is stunted and peculiar to the bog at Wahiawa, while the other is a tree in the forests of Kaholuamano on the high plateau of the Waimea district.

Var. *prostrata* occurs in the high mountain bogs at the summits of Waialeale of Kauai and Puukukui of West Maui; on Molokai it grows in the Kawela swamp at an elevation of 4000 feet; its form *strigosa* is only found in the summit bog of Kohala, Hawaii, in company with *Viola*, *Plantago*, *Vaccinium*, *Oreobulus*, etc.

Molokai harbors another rather interesting variety, var. *Fauriei*, it is a handsome, medium sized tree and favors the lee side of the island, especially the open slopes and sides of gulches, as in Mapolehu and Kamolo.

There remains only one more variety, var. *glaberrima*, very plentiful on Oahu in the mountains of the main range; its form *sericea* is found on Oahu as well as on Hawaii, Kauai, Molokai and Lanai, and probably also on Maui. For further, more detailed references to location, see under each species and variety in the systematic part.

a



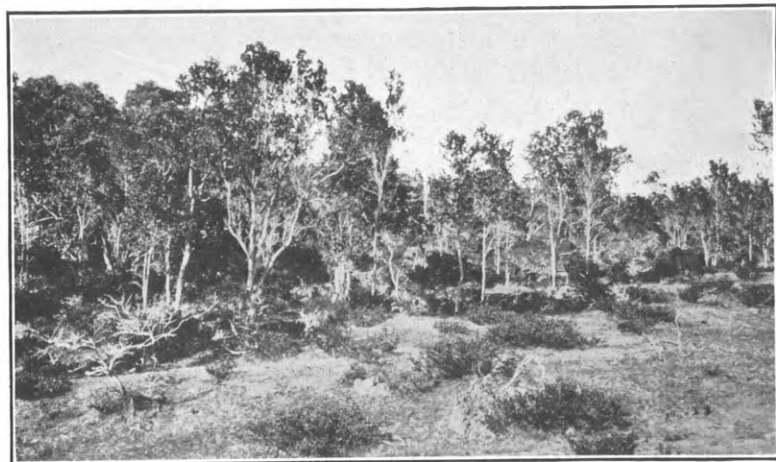
A rather recent (pahoehoe) smooth lava flow, with *Metrosideros collina polymorpha* var. *incana*, and *Sadleria cyatheoides* growing on its margin. An overflow from the Volcano of Kilauea, Hawaii, on to the ash fields of Kau desert.

b



The two floors of a crater occupied solely by *Metrosideros collina polymorpha* var. *incana*. The crater is one of the numerous ones found in the vicinity of Kilauea on Hawaii. The trees on the lower floor are 50-60 feet in height.

c



An old aa or rough lava flow occupied by *Metrosideros collina polymorpha* var. *incana*, and encircling an ancient kipuka or oasis with a most varied arborescent vegetation, and where no trace of lava can be found.

METROSIDEROS COLLINA POLYMORPHA VARIETY INCANA ON HAWAII

The variety *incana*, as already remarked in the systematic part of this paper, is the most common variety on the Island of Hawaii, in fact the bulk of the forests which cover the geologically younger land areas, is composed of this variety. Of all *Metrosideros* the variety *incana* seems to be the most able to adapt itself to almost any altitude and environment. On Hawaii variety *incana* is ever present, as near the sea shore, in the forests of Puna and the forest belt on the slopes of Mauna Kea (windward side), the forests of Mauna Loa on both the leeward and windward slopes. It is most common around the Volcano of Kilauea where it grows on the open cinder fields near Halemaumau, along the hot steam cracks and fissures near and at the sulphur banks where they are covered with the whitish yellow sulphur deposits giving it the appearance of being covered with snow. Even under such conditions, as within the reach of steam, issuing from the volcanic depths below, variety *incana* flowers and fruits profusely.

To be sure it does not reach the size of a tree, but is more shrubby and rarely higher than fifteen feet. In the forests of the immediate neighborhood of Kilauea, variety *incana* forms pure stands, the trees being usually 40 to 50 feet in height with tree ferns forming the main undergrowth save a species of *Pipturus* which grows usually on the outskirts. (See plate IX). This ohia lehua forest becomes less dense as it approaches the cinder field near the actual crater and the smaller one of Keanakakoi. The trees decrease in size and are scattered rather than growing in stands, while on the floor of the crater Keanakakoi it lives only in cracks of the basaltic pahoehoe lava. (See plate IX b.) The adjacent land passes gradually into the Kau desert practically devoid of all vegetation, not due to lack of rainfall, but mainly to the composition of the volcanic ash, which on coming in contact with moisture becomes cemented and forms thus a surface similar to hard pan on which plants cannot establish themselves. Besides the prevailing wind brings with it the dense sulphurous fumes of Halemaumau crater, which sweep this desert continuously. (See plates X b, and XI a.)

However variety *incana* is not absent in the most desolate of all regions. The Kona (south) wind causes during the winter months heavy downpours and consequently rivulets form in the beds of which variety *incana* has found it possible to exist. The young plants found in these locations are often completely enwrapped by the so called "Pele's Hair," which is simply lava spun into hair like threads and blown about and carried by the wind over large areas. Variety *incana* thrives in the cracks of the smoothest (pahoehoe) lava, as well as on the roughest and most recently ejected aa lava. (See plate IX c.) It covers the old aa (rough) lava flows of both south and north Kona, as well as the pahoehoe (smooth) lava flows on the upper slopes of Mauna Loa along the trail leading to Mauna Kea elevation 5000-6000 feet. There it grows in pure stands without undergrowth save the bracken fern (*Pteridium aquilinum*) and a few other herbaceous plants. These forests cover only the newer land. They are bordered by koa forests (*Acacia koa*), pure stands of magnificent trees which cover only the geologically older regions; the demarcation between these two forest types is so distinct that one could divide them by ropes. (See plate X a.)

Variety *incana*, it will be remembered, is the closest *Metrosideros* to the South Sea Island *Metrosideros collina*. The latter has the widest distribution of any *Metrosideros* known and it may not be wondered at that its closest congener, with which it may have been once identical, should have such wonderful adaptability to the most varied environments.

The smaller illustrations show variety *incana* on the various above cited locations. (Plates IX, X, XI.)

Insects injurious to ***Metrosideros collina***, subsp. ***polymorpha*** in the Hawaiian Islands*

Homoptera.

Delphacidae. The endemic genera of Hawaiian Delphacidae belong to the tribe Alohini, of which two species are known outside of the Hawaiian archipelago, viz., one in Australia and one in South America. The Hawaiian genera form two groups, the *Leialohae* consisting of two genera, *Leialoha* and *Nesodryas*; and the *Alohae* with four genera, only *Leialohae* are known to live upon *Metrosideros*. There are a good many reasons to believe that the *Alohae* were much earlier immigrants into the Hawaiian archipelago than the *Leialohae*. Of the two genera, *Leialoha* and *Nesodryas*, the former is the more primitive. At present it consists of five species and three subspecies. The food plant of two species (*oceanides* from Kauai, and *pacifica* of uncertain locality) is unknown, the others all feed upon *Metrosideros*. Two species of *Nesodryas*, *N. gulickii* and *N. maculata*, both from the lava flows of South Kona feed upon *Metrosideros*.

Tetigoniidae.

No species are recorded as feeding on *Metrosideros*, although several species do feed upon it.

Psyllidae.

Several species belonging to this family are attached to *Metrosideros*, only one of which is described at present, *Trioza iolani* Kirk., which forms galls on the leaves.

Coleoptera.

There are several beetles of the genus *Plagithmysus* which live in the wood of the *Ohia* tree. Their names and localities are as follows:

P. bilineatus on Hawaii.

P. lanaiensis on Lanai.

P. pulvillatus on Maui.

P. aestivus on Molokai.

Lepidoptera.

The following moths and their larvae live on *Metrosideros*:

Philodora splendida Walsm. Leaf-miner.

Eccopectera foetorivorans Butt. On leaves and in buds.

Heterocrossa distincta Walsm. In leaf buds.

The larvae of the following three species of moths live in cases on lichens found on the bark of *Metrosideros*:

Hyposmocoma metrosiderella Walsm.

Hyposmocoma bacillella Walsm.

Hyposmocoma subcitrella Walsm.

* For the information contained in this chapter the writer is indebted to Mr. Fred. Muir and Mr. Otto H. Swezey, Entomologists at the Hawaiian Sugar Planters' Experiment Station.

Metrosideros Banks

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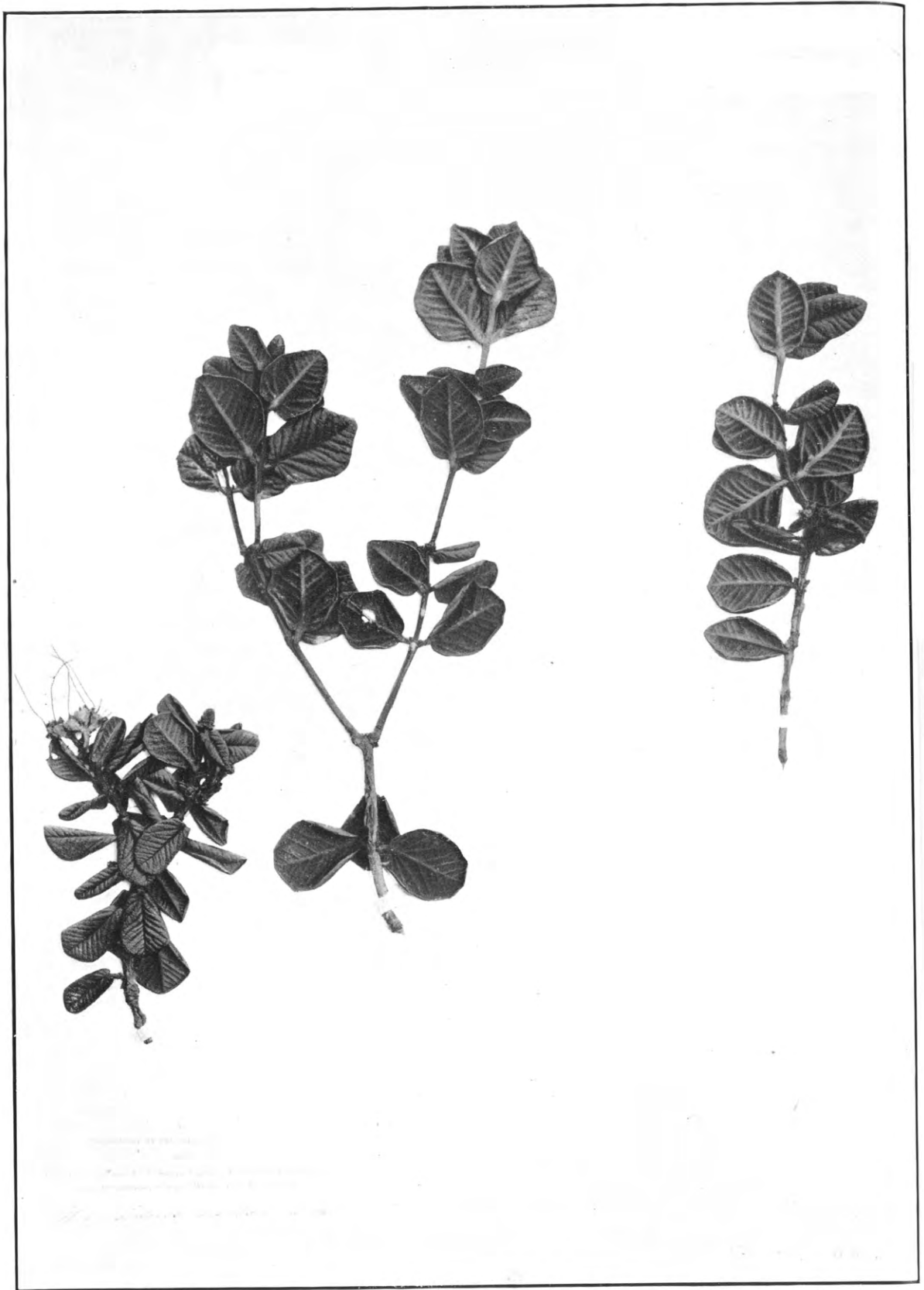
SYSTEMATIC PART.

KEY TO SPECIES

- Leaves on short petioles up to 2 cm.
- Leaves faintly nerved, capsules almost free;
- Branches drooping, slender, numerous, leaves narrow lanceolate, petioles flat, slightly winged, 6 mm..... **M. tremuloides**
- Branches ascending stiff:
- Leaf-buds divaricately spreading, long, narrow cylindrical, acuminate; leaves caudately acuminate **M. Waialealae**
- Leaf-buds large, broad, obtuse and erect **M. collina polymorpha**
- Leaves deeply rugose, impressed above, the strong nerves ridged below; capsule adnate to near the apex **M. rugosa**
- Leaves on long petioles of 2.5-5 cm. **M. macropus**

KEY TO THE VARIETIES AND FORMS OF **METROSIDEROS**
COLLINA POLYMORPHA

- Leaves woolly or canescent, inflorescence woolly:
 Leaves thick coriaceous, densely woolly underneath:
 Leaves orbicular, cordate, subsessile
 var. **a typica**
 Leaves obovate to elliptical oblong, rounded at the base, petiole 6-12 mm:
 var. **incana**
 Leaves thin, canescent, imbricate
 var. **imbricata**
- Leaves glabrous:
 Inflorescence woolly:
 Trees:
 Leaves thick coriaceous, suborbicular cordate, subsessile, petioles
 about 1 mm., capsule large
 var. **Haleakalensis**
 Leaves subcoriaceous, elliptical, acute at both ends, petioles 6-10
 mm., capsule small
 var. **Newellii**
- Shrubs or creepers:
 Shrub, leaves broadly ovate, petioles stout, 6 mm. (growing in
 Wahiawa swamp, Kauai, only).....
 var. **pumila**
 Creeper, leaves small suborbicular to ovate, (growing summit
 swamps)
 var. **prostrata**
- Inflorescence silky, canescent or glabrous:
 Inflorescence silky canescent:
 Petioles long 1-2 cm.:
 Leaves linear-oblong, bluntly acute at both ends, capsule
 glabrous
 var. **Fauriei**
 Leaves large, ovate, obtuse at apex, truncate at base, capsule
 canescent
 var. **macrophylla**
 Petioles short, less than 3 mm., leaves broadly cordate at base....
 var. **glabrifolia**
- Inflorescence glabrous, glabrous in all parts, leaves variable, petioles
 3-10 mm.
 var. **glaberrima**



Metrosideros rugosa A. Gray. Type in Gray Herbarium.

Metrosideros rugosa, A. Gray, Bot. U. S. Expl. Exp. 14: 561, T. 69
B. (not A.) 1854.

Metrosideros polymorpha, Drake del Cast. Ill. Flo. Ins. Mar. Pacif. VI: 167.
1890.

Nani rugosa O. Ktze. Rev. Gen. Pl. I: 242. 1891.

A small tree or shrub, with quadrangular branchlets, only the ultimate ones tomentose; leaves orbicular, about 2.5 cm. in diam., thick coriaceous, strikingly bullate rugose above, with the strong pinnate veins impressed, very prominent underneath as well as the thick costa, upper surface minutely pubescent when young, but soon glabrate; the lower tomentose with a thick and close, nearly persistent, tawny and ferruginous wool, as are the leaf buds on both faces; petioles very short, scarcely 2 mm.; cymes small, solitary or in pairs at the summit of the branches, peduncles and their divisions short and stout, whitish tomentose, the whole subtended by rather conspicuous and coriaceous bud scales, which are somewhat persistent after the evolution of the cyme; bractlets as long as the calyx, oval, tomentose, somewhat ferruginous, soon deciduous; pedicels very short or scarcely any; flowers large; calyx densely tomentose with whitish wool outside, turbinate, five-lobed; petals and stamens deep red, the former slightly pubescent; ovary deeply immersed in the bottom of the calyx, three-celled, its summit only free.

OAHU: On the mountains behind Honolulu, A. Gray;—Gaudichaud, Voy. Bonite;—dry hills back of Honolulu and Niu Valley, Hillebrand;—Koolau Mts., open ridges overlooking Hauula, elev. 2500 feet, flowering Aug. 17, 1908, Rock, No. 138, in College of Hawaii Herb. (two sheets);—Punaluu Mts., flowering Nov. 14-21, 1908, Rock, No. 646, in College of Hawaii Herb.;—same locality, flowering Dec. 24-29, 1908, Rock, No. 922, in College of Hawaii Herb.;—summit of Koolau range between Mt. Olympus and Kona-huanui, overlooking the precipice above Waimanalo, April, 1913, Rock.

The *Lehua papa*, as this species is called by the natives, is certainly distinct, and is confined to the Island of Oahu, where it grows in open situations, but rarely on the dry hills, as Hillebrand states; on the contrary, it is confined to the very summits of the windswept ridges, which are more or less hidden in trade wind clouds. It is never really a tree, but usually a bush or shrub, growing on the vertical cliffs or palis on the windward side of the island, only in the Punaluu Mts. did the writer observe it as a small tree, 10 feet or so in height. It is a handsome species and conspicuous on account of its dark green, rugose foliage, which is ochre colored, and woolly underneath, and its bright scarlet flowers, which are terminal.

The plate in the Atlas of the U. S. Exploring Expedition is erroneously marked; the plant designated by the letter "B" is *Metrosideros rugosa*, and not "A."

In the Gray Herbarium is one sheet of this species, a co-type of Asa Gray's, with what is probably the original drawing for the Atlas of the Botany of the U. S. Exploring Expedition. The specimen was distributed by the Smithsonian Institute. On the same sheet is a small specimen of this species collected by Gaudichaud during the visit of the Bonite.



Metrosideros macropus Hook. et Arn.

Metrosideros macropus Hook. et Arn. Bot. Beech. Voy. 83. 1841.
Nani macropus O. Ktze. Rev. Gen. Pl. I: 242. 1891.

A well-proportioned tree of considerable size, glabrous throughout; the branchlets angled; leaves ovate or ovate-oblong, coriaceous, rather dull, acute at the base, either rounded, obtuse, or somewhat acute at the apex, obscurely punctate, copiously feather-veined, the veins oblique, very slender, equally conspicuous on both sides, connected by minute reticulations, terminating in an infra-marginal nerve; petioles elongated, sometimes almost as long as the blade, 2.5-5 cm. long, usually margined, and standing nearly at right angles to the stem; cymes terminal, usually geminate, subsessile, many-flowered, crowded, evolved from a large scaly bud, the scales of which remain persistent for some time, as ovate or oblong pointed bracts, of a coriaceocharaceous texture, 12 mm. in length; the pedicels about 4 mm., subtended by smaller ovate-lanceolate, early deciduous bractlets; flowers large, calyx glabrous or barely puberulent, petals and stamens pale or flesh-color; ovary three-celled, the glabrous summit free barely to the middle; capsule nearly included in the turbinate tube of the calyx, the spreading lobes of which are persistent, free to the middle, adnate below, three-valved, many seeded; seeds fusiform-subulate, not much pointed.

OAHU: On the mountains behind Honolulu, Macrae, Lay et Collie, Gaudichaud, Seeman, U. S. Expl. Exped., Remy No. 642, Mann et Brigham;—Mt. Waiolani, Wawra No. 1656 in Herb. Vienna;—Nuuanu to Palolo, Hillebrand;—Mts. of Waikane, windward side of Oahu, flowering and fruiting Jan. 23, 1909, Rock, Nos. 1229 (flowering), 1230 (fruiting) in College of Hawaii Herb.;—Kalihi Valley, Oct., 1909, Abbe Faurie No. 22, Herb. St. Louis College, Honolulu.

This species is quite distinct from the other species of *Metrosideros* and differs from them mainly in the long petioled leaves, large floral scales, very large flowers, and large capsules which are nearly included in the calyx tubes.

It is a tree of considerable size and is not uncommon in the mountains of Oahu, especially on the main Koolau range, in the middle forest zone. The writer found this species most plentiful on the ridges of Waiahole and Waikane. The flowers are not red, but pale or flesh-colored.

Léveillé describes two hybrids, one \times *Nania* (*Metrosideros*) *Fauriei* (*N. macropus* Hook. et Arn. \times *N. polymorpha* Gaud.) which does not belong here; the other: \times *Nania* (*Metrosideros*) *Feddei* (*N. polymorpha* Gaud. \times *N. macropus* Hook.), which is quite a distinct species and known as *Metrosideros tremuloides* (Heller) P. Knuth.

The variety *microphylla* Lévl. of *Metrosideros macropus*, collected by Faurie at Koloa, Kauai, is not known by the writer. Co-types of the two above mentioned (supposed) hybrids are in the College of Hawaii Herbarium.

In the Gray Herbarium is a specimen (fruits only) from the Herb. of the U. S. South Pacific Expl. Expedition, with the original drawings which served for the illustration in the Atlas of the Botany of the above-mentioned expedition. On the same sheet is a paper pocket containing a few fruits, and the following legend:

"From Byron's Bay, Hawaii, Macrae! Is a spec . . . (part of the line is not legible) by Planchon." "Specimen inter *M. polymorpha* Gaud. et *M. macropus* H. et A. medium invalidating the two species." It bears the number 1731. The fruits are identical with those of the U. S. Expl. Expedition. On the same sheet is a flowering specimen collected by Seeman on Oahu with the same number 1731, and another specimen collected by Gaudichaud, on Oahu, visit of



Metrosideros Waialealae Rock. Type in College of Hawaii Herbarium.

the Bonite. The Seeman specimen has almost orbicular leaves, while that of Gaudichaud has obovate leaves.

Another sheet (flowering specimen) collected by Macrae, May, 1825, on Oahu, belongs here, the leaves are ovate acute. A very handsome specimen with flower buds and mature fruits collected by W. T. Brigham on Oahu in 1865, also in the Gray Herbarium, shows the floral scales to great advantage, as they are usually deciduous at the maturity of the flowers.

Heller's No. 2762, labeled *Nania macropus* (H. et A.) Kuntze, has nothing in common with *M. macropus* H. et A. It belongs to *M. collina* subsp. *polymorpha* var. *glaberrima* (Lévl.) Rock; this specimen came from Hanapepe, Kauai,

The writer is of the opinion that the few fruits marked as having come from Byron's Bay, Hawaii, by Macrae, might have been mixed up, and that they really belong to his Oahu specimen. So far the true *M. macropus* has not been found outside of Oahu.

Metrosideros Waialealae Rock.

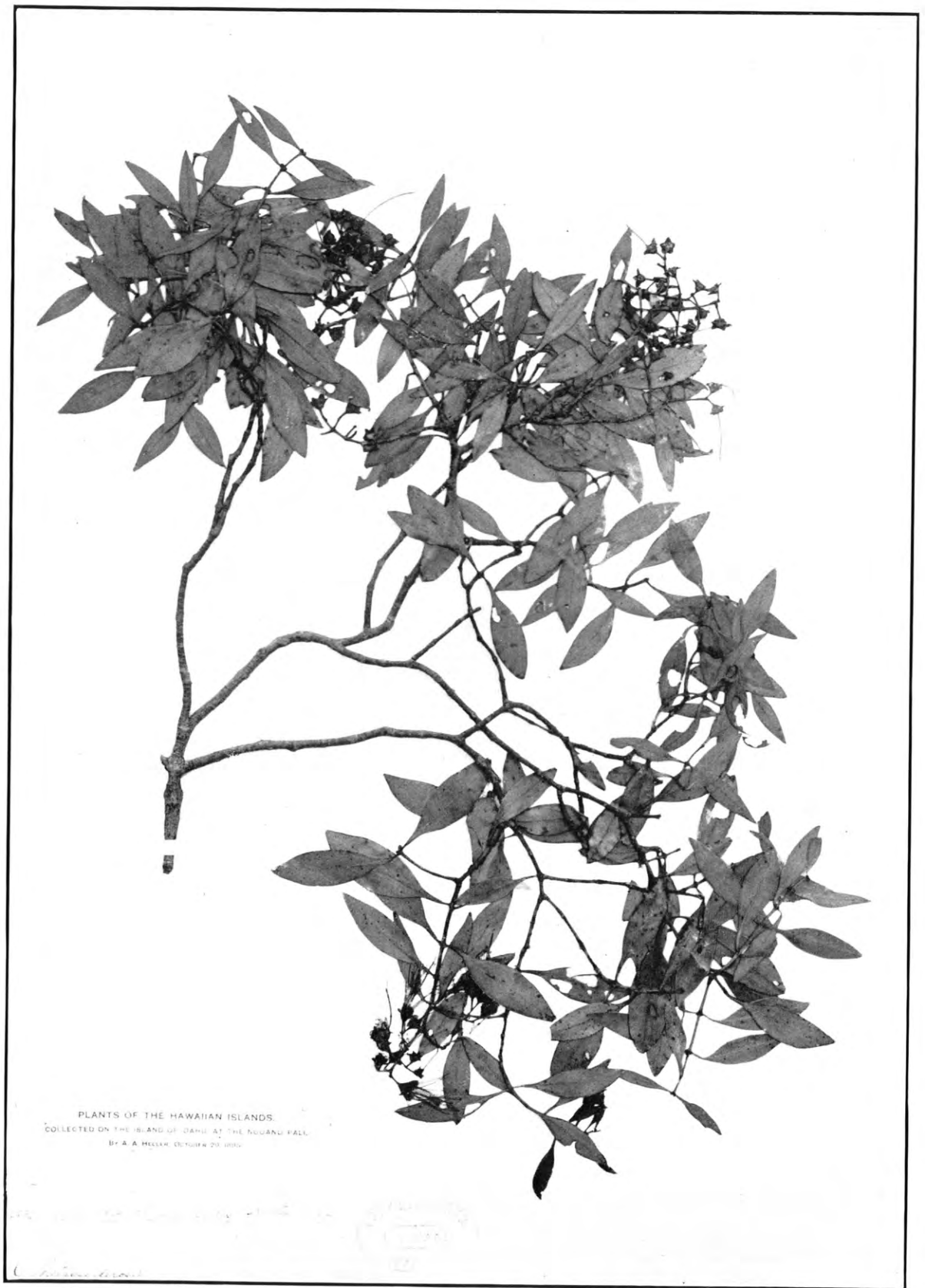
Metrosideros tremuloides var. *Waialealae* Rock, Indig. Trees Haw. Isl. 335. 1913.

A medium-sized tree, 10 m. or more in height; sparingly branched, branches ascending glabrous, terete; leaves bright pale-yellowish green, with carmine midrib and leaf-margin, veins protruding and prominent above, paler than the leaf, the infra-marginal nerve close to the edge, thick coriaceous, 5-7 cm. long, 2-2.5 cm. wide, elliptical-oblong to ovate, caudately-acuminate at the apex, acute at the base and merging into a flat, bright red petiole of 15-20 mm.; cymes terminal, large and many-flowered, 4 cm. in height; peduncles 1.5 cm. or more, glabrous; pedicels 2 mm.; flowers large, bright red; calyx green, glabrous, with reddish margins; petals large, obovate, rounded; stamens 2 cm.; the stigma 2.5 cm.; fruits as large as in *M. macropus*, the calyx-lobes persistent, prominently 5-ribbed, the capsule free from the calyx tube, and projecting beyond the latter; seeds linear, lunulate, pointed at each end.

KAUAI: Near summit ridge leading to Mt. Waialeale, elevation 5200 feet, flowering and fruiting Sept. 24, 1909, Rock, type No. 5083, in the College of Hawaii Herbarium;—same locality, flowering Oct. 20, 1916, Rock and Hitchcock, No. 12781 in College of Hawaii Herbarium and A. S. Hitchcock, No. 15486 in U. S. Nat. Herbarium.

A very interesting and rather distinct species which resembles somewhat *M. tremuloides*. It comes close to *M. macropus* in the long petioles, but differs from it in the absence of floral scales and bracts, the free capsule projecting beyond the calycine tube.

It is a striking species and perhaps the handsomest *Metrosideros* occurring in these Islands. It has so far only been found on a single ridge leading from Kaluiti and Kailiili stream to the summit of Waialeale, where it forms a pure stand of an acre or so in extent.



Metrosideros tremuloides (Heller) P. Knuth.

Metrosideros tremuloides * (Heller) P. Knuth Handbuch der Blutenbiologie 3: 532. 1904.

- Metrosideros tremuloides* (Heller) Rock Indig. Trees Haw. Isl. 333, Pl. 133. 1913.
Metrosideros polymorpha Gaud. var. ζ Gray (in part) Bot. U. S. E. E., 653. 1854.
Metrosideros polymorpha Gaud. var. 6 H. Mann, Proc. Ess. Inst. 5: 244. 1867.
Metrosideros polymorpha Gaud. var. η Hbd. Flora Haw. Isl. 127. 1888.
Nani (a) tremuloides Heller in Minnes. Bot. Stud. 9: 866. 1897.
 x *Nania (Metrosideros)* Feddei H. Lévl. in Fedde Rep. Spec. Nov. 10: 150. 1912.
Metrosideros polymorpha Gaud. var. β Rock in part (No. 4829). Indig. Trees Haw. Isl. 327. 1913.

A small tree, with slender trunk, bark grayish, smooth, glabrous throughout; branches many, slender, loosely spreading; leaves narrow-lanceolate, acute or acuminate at both ends, 3.5-5 cm. long, 10-16 mm. broad, on slightly winged or flat petioles of 6 mm., bright green, shining above, paler and dull underneath, coriaceous, not prominently veined, but midrib conspicuous, leaf margins, midrib and petioles of a reddish color; cyme branches divaricate; peduncles slender, of varying length, hardly longer than 10 mm.; ultimate pedicels about 3 mm.; calyx campanulate, the lobes rounded and equaling the tube in length, encircled by a lighter green, minutely ciliate or scarious margin of one-third of a millimeter in width; petals bright red, almost orbicular, twice the length of the calyx lobes, the margins scarious; stamens bright red, barely 2 cm. in length; style 2 cm.; capsules half free.

OAHU: Gaudichaud, voyage Bonite;—U. S. E. E. (1838-42);—Mann and Brigham No. 96a;—in sheltered gulches on the lee side of Oahu, Hillebrand, July, 1865;—at the Nuuanu Pali, Oct. 29, 1895 Heller No. 2895;—at the head of Pauoa Valley, flowering Jan. 8, 1910, Rock No. 137, and eastern ridge of Niu Valley, flowering Aug. 22, 1909, No. 4827;—Kalihi Valley, flowering Oct. 1909, Abbe Faurie No. 25, No. 12611 in the College of Hawaii Herbarium.

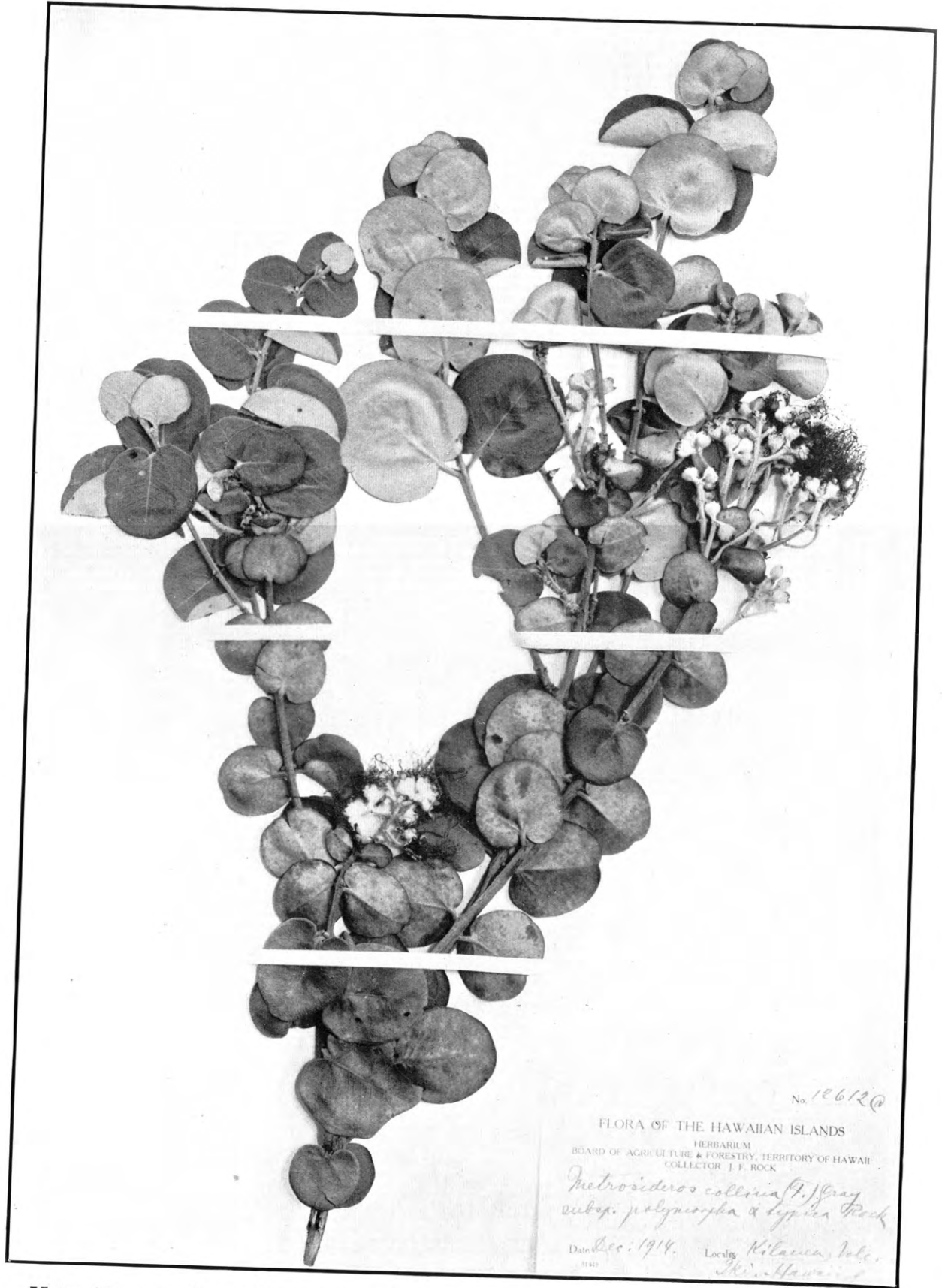
One of the handsomest and most graceful of the species of the genus *Metrosideros*. The natives know this species by the name *Lehua ahihi*. The bright green foliage with the reddish margin, midrib and petiole, stands out quite distinct from all the other species. It is entirely glabrous, even calyx and corolla, which are usually covered with a silvery tomentum in the other species or varieties. The branches are numerous, drooping, terete and very slender, and nearly always in motion, hence the specific name.

The species was collected by nearly all the earlier botanists and exploring expeditions, and was first described by Gray, though it may be Gaudichaud's var. γ mentioned in the Voyage Uranie. H. Lévellé's x *Nania Feddei* is the typical *Metrosideros tremuloides*, not a hybrid.

The tree is peculiar to the main range of Oahu, especially common in the valleys of Kalihi, Manoa, Nuuanu and Pauoa, though occurring as far east as Niu Valley. Hillebrand mentions it from Kauai, but the writer has not seen specimens nor has he collected it on that island.

In the Gray Herbarium are several sheets with specimens of the typical *Metrosideros tremuloides*, though mounted often with other varieties of *M.*

* The writer was not aware that Prof. P. Knuth had placed Heller's *Nani (a) tremuloides* into *Metrosideros* at the time of publication of the Indigenous Trees of the Hawaiian Islands. Prof. Knuth's book is not available in Honolulu.



Metrosideros collina (Forster) Gray subsp. *polymorpha* (Gaud.) var. *a typica* Rock.

polymorpha. A co-type of the species (Heller No. 2895) is in the Gray and College of Hawaii Herbaria.

Specimens examined:—Heller No. 2895, Hillebrand (July, 1865) without number;—U. S. Exploring Expedition labeled *M. polymorpha* ζ;—Mann and Brigham No. 96a, labeled *M. polymorpha* ζ;—several fragments of this species mounted with other specimens from the voyage Bonite, Gaudichaud. All these specimens are in the Gray Herbarium, Harvard.

Seeman's No. 171 of *Metrosideros polymorpha* var. β with yellow flowers, from Fiji, collected by him in 1860 (specimen in Gray Herbarium) comes very close to *M. tremuloides* in general appearance, but differs from it in the sessile yellow flowers and much contracted cymes. A. Gray unites Seeman's var. β 171 with his *M. collina* var. *vitiensis*, also from Fiji, but it has not much in common with it. Gray's var. *vitiensis* has a silky canescent inflorescence, and broader ovate elliptical leaves, while Seeman's No. 171 has a much contracted perfectly glabrous cyme and leaves as in *M. tremuloides*. Seeman's var. α with red flowers, No. 170, seems also closely related to it.

***Metrosideros collina* (Forster) A. Gray subsp. *polymorpha* (Gaud.)
α *typica* Rock**

Metrosideros polymorpha Gaud. Bot Voy. Uranie, 482, Pl. 108. 1826.

Metrosideros polymorpha Gaud. var. β Gray, Bot. U. S. E. E., 562. 1854.

Nania polymorpha Gaud. var. *nummularifolia*. Lévl., in Fedde Report, Spec. Nov. 10: 149. 1911.

Metrosideros polymorpha Gaud. var. ι Rock Indig. Trees Haw. Isl. 331, Pl. 138. 1913.

A medium-sized tree 5-10 m. high, with robust terete branches; leaves thick coriaceous, orbicular to suborbicular, 1.5-6 cm. in diameter; dull glabrous above, or somewhat shining (in Oahu specimens) cordate at the base and often retuse at the apex, densely gray or white-woolly underneath, intramarginal nerve 1-2 mm. from the leaf-margin, the nerves raised and prominent; petioles short, pubescent, 2-4 mm.; inflorescence a cyme or open raceme, densely white-woolly as are the calyx, calyx-lobes and in part the petals; ultimate pedicels very short, 1-3 mm.; bracteoles ovate, rounded, woolly, 3-5 mm.; calyx large and broad 5 mm. including the rounded lobes; petals rounded; stamens about 2 cm.; style about 23 mm. long, protruding; capsule densely woolly, about 6-7 mm., exerted from the calycine tube.

OAHU: Mann and Brigham, No. 72;—Nuuanu Valley, 2000-3000 feet, Hillebrand;—slopes of Konahuanui, above Manoa, flower-Nov. 12-13, 1895, Heller No. 2375;—Koolau Mts., Kalitwaa Ridge, above Hauula, without flowers or fruit, Dec. 24, 1908, Rock, No. 847 in College of Hawaii Herbarium.

KAUAI: Hbd.?—Specimens not seen;—U. S. E. E.

MAUI: Hbd.?—specimens not seen;—U. S. E. E. Crater of Haleakala, specimens not seen.

HAWAII: Gaud.? (Sandwich Islands);—near the coast and on Mauna Loa, U. S. E. E., 1838-1842;—mountains of Hawaii, Hbd.;—Volcano of Kilauea, May, 1909, Faurie, No. 34;—summit of Mt. Hualalai, Honuauulu Crater, fruiting June 9, 1909, Rock, No. 3712;—lava beds on slopes of Mt. Hualalai, North Kona, flowers yellow, flowering June, 1909, Nos. 3633, 3635, 3617, and 3626;—Volcano of Kilauea, flowering Dec., 1914, Rock, Nos. 12612 and 12613a from Kilauea-iki.



Metrosideros collina (Forster) A. Gray subsp. **polymorpha** (Gaud.) var. **imbricata** Rock.
Type in Gray Herbarium.

The variety *a typica*, which is identical with Gaudichaud's type of *Metrosideros polymorpha*, plate 108 in Botany Voyage Uranie, is a rather small tree with gnarled trunk and branches, and occurs on the islands of Oahu, Maui and Hawaii. It is distinguished from the other varieties in the cordate, subsessile or shortly pedunculate, suborbicular leaves, which are densely woolly underneath, as is the whole inflorescence. The specimens from Oahu and Mt. Hualalai, Hawaii, have a rather contracted cyme, while those from the neighborhood of the Volcano of Kilauea, Hawaii, have large open cymes to a racemose inflorescence. The leaves of the Oahu specimens differ from the Hawaii specimens in being somewhat shiny above and have an impressed midrib. The specimen No. 3712, from the summit of Mt. Hualalai, Honuauulu Crater, has very small leaves and tomentose branches, the woolliness on the leaves is grayish and that of the younger leaves or buds yellowish. The bark is thin, reddish and peels off in small flakes. The variety *a typica* was collected practically by all the earlier botanists. Besides occurring on Oahu and Maui, it is common in the neighborhood of the Kilauea Volcano, Hawaii, where it grows along the sulphur bank and hot steam cracks as a shrub or small tree, usually covered with sulphur.

***Metrosideros collina* (Forster) A. Gray subsp. *polymorpha*, var *imbri-cata*, Rock.**

Metrosideros polymorpha Gaud. var. *a* A. Gray, Bot. U. S. E. E. 562. 1854.

Metrosideros polymorpha Gaud. var. 1 H. Mann, in Proc. Essex Inst. 5: 243. 1868.

Metrosideros polymorpha Gaud. var. *ι* Rock, Indig. Trees, Haw. Isl. 331. 1913.

A small tree or shrub, leaves rounded, thin in texture, cordate, subsessile or very shortly petiolate, crowded on the branches and often imbricate, becoming gradually smaller towards the apex of the branchlets, canescent below, glabrous and shining above, 6. mm.-3 cm. in diameter, the veins scarcely visible; cymes contracted or elongate, canescent to white-tomentose, flowers small; calyx white tomentose, with the exception of the tips of the calycine lobes, the margin of the latter as well as that of the red petals, whitish pubescent; stamens about 2 cm., style slightly longer; capsules small, 4 mm. tomentose, the valves projecting from the calyx and glabrous.

OAHU: Gaud. Voyage Bonite in Gray Herbarium;—Seemann No. 2288 in Gray Herbarium;—mountains behind Honolulu, U. S. E. E., in Gray Herbarium;—Kaliuwaa Valley, flowering Aug. 15, 1908, Rock, No. 720;—Pauoa Valley, fruiting Oct. 26, 1908, Rock, No. 722;—mountains of Punaluu, May, 1909, Faurie, No. 33 (?).
HAWAII: Hillebrand (doubtful), specimens not seen.

This rather distinct variety differs from the var. *a typica* mainly in the subsessile, imbricately arranged suborbicular, rather thin, leaves, and in the smaller flowers and capsules. It occurs in the mountains behind Honolulu on high exposed ridges. Hillebrand records it also as growing in the Kohala Mountains on Hawaii. It is Hillebrand's and Asa Gray's var. *a* and the writer's var. *ι* No. 722, in the Indigenous Trees of the Hawaiian Islands, and probably Faurie's var. *sessilis*, No. 33, from the Punaluu mountains.

The specimens from Kaliuwaa Valley (No. 720) have the leaves less imbricate and slightly larger, but otherwise exactly the same.

In the Gray Herbarium are three specimens each by a different collector (Gaudichaud, Seemann, and U. S. E. E.) on one sheet, which is here reproduced and is the type of var. *imbri-cata* Rock.



No. 12613
FLORA OF THE HAWAIIAN ISLANDS
COLLEGE OF HAWAII HERBARIUM
COLLECTED BY J. F. ROCK, 1916, *Males*
Metrosideros collina (Forster) A. Gray
subsp. *polymorpha* var. *incana*
J. F. Rock
Locality *Hilo, Hawaii*
Date *Apr. 1916.*

Metrosideros collina (Forster) A. Gray subsp. **polymorpha** var. **incana** (Levl.)

***Metrosideros collina* (Forster) A. Gray, subsp. *polymorpha* var. *incana* (Lévl.) Rock.**

Metrosideros polymorpha Gaud. var. β Gray in part, U. S. E. E., 562. 1854.

Metrosideros polymorpha Gaud. var. ϵ Hbd. Fl. Haw. Isl. 126. 1888.

Nania polymorpha (Gaud.) var. *incana* Lévl. in part, in Fedde Repert. Spec. Nov. X: 149. 1911.

A shrub or tree reaching a height of 30 m. or more; trunks straight ascending; sometimes two or three from the same root stock; bark gray, outer layer falling off in flakes or strips; branches stiff, more or less ascending, terete or angular when young; leaves coriaceous, obovate, ovate or elliptical-oblong, acute or usually obtuse, cinereo-tomentose on both faces, but older leaves becoming glabrous above, 2.5-7.0 cm. long, 2-4 cm. wide, on petioles of 6-12 mm.; cymes densely tomentose, many-flowered, pedicels very short, 1-5 mm.; calyx white-woolly, 5 mm., including the lobes; petals oblong, tomentose or glabrate, with ciliate margins; capsule grayish woolly, slightly exserted, or immersed in the Kauai specimens.

OAHU: Hillebrand, specimens not seen.

KAUAI: U. S. Expl. Exped.;—Lehua makanae swamps back of Kaholuamano, elev. 4200 feet, flowering March 3-10, 1909, Rock, No. 2043, and flowering and fruiting Sept. 6, 1909, No. 5885, in College of Hawaii Herbarium.

MOLOKAI: Hillebrand;—Waiau Gulch near Maunahui, flowering March 21, 1910, Rock, No. 6174 in College of Hawaii Herbarium;—Kamolo, June, 1910, U. Faurie, No. 28.

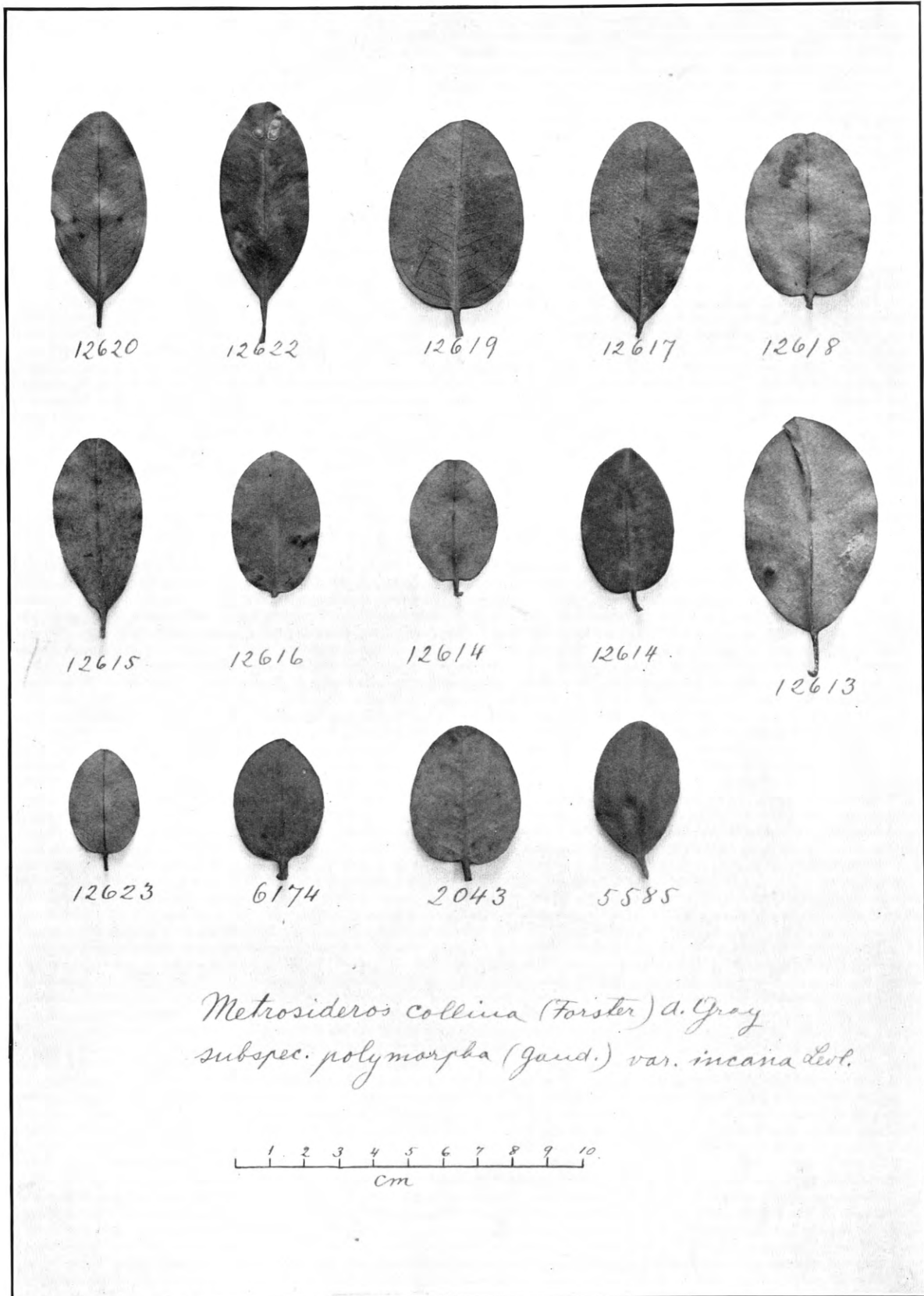
MAUI: U. S. Expl. Exped., Crater of Haleakala?;—Hillebrand, specimens not seen.

HAWAII: U. S. Expl. Exped., both near the coast and on Mauna Loa;—Kona, Puna and Hilo, Hillebrand;—Piionua gulch and lava flow back of Hilo, flowering and fruiting Feb., 1916, Math. Newell, Nos. 12613 to 12623, inclusive;—Kipuka Puauulu, near Volcano, Kilauea, 4200 feet, flowering April 22, 1916, Rock, No. 12634 in College of Hawaii Herbarium;—Volcano Kilauea vicinity, flowering April 22, 1916, Rock, Nos. 12635 and 12636;—Kau, on 1868 smooth (pahoehoe) lava flow, flowering April 23, 1916, Rock, No. 12637, in College of Hawaii Herbarium.

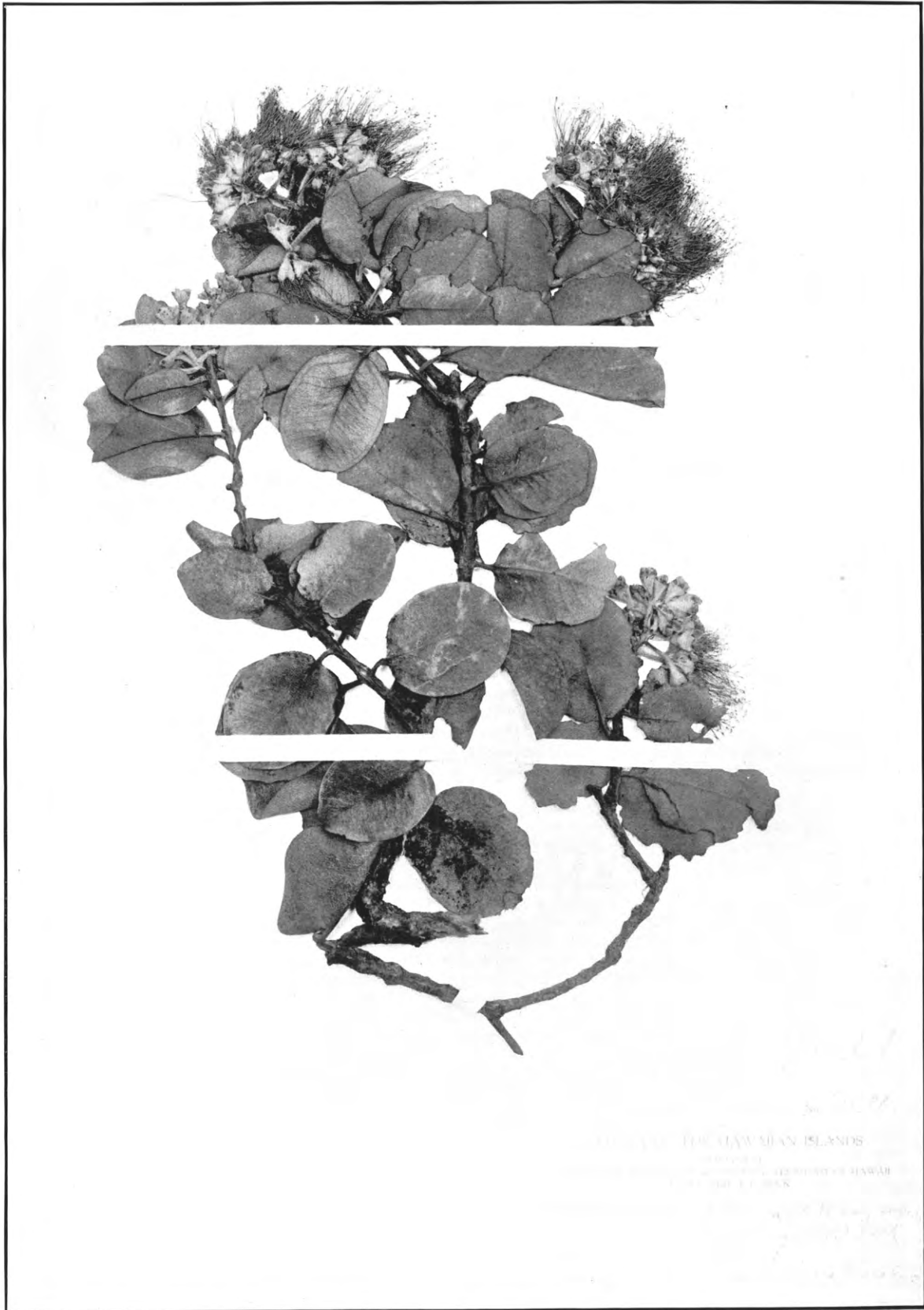
Var. *incana* is the most common variety on the Island of Hawaii, where it forms the somber forests extending from Puna to the Volcano of Kilauea, Kau and Kona. It is the tallest variety in the Hawaiian Islands, sending up straight trunks their entire length, save at the very apex, having only very short branches along the main bole. It thrives on a-a (rough) lava as well as on pahoehoe (smooth) lava, in black cinder and rich decomposed volcanic soil, and is an epiphyte on tree ferns in the wet forests.

Var. *incana* is Hillebrand's var. ϵ and is included in Gray's var. β which embraces all the various tomentose forms found on Hawaii, with the exception of var. *Newellii*. It certainly comes close to Gray's var. β , which is var. *a typica*, with orbicular cordate leaves, in this treatise. Léveillé includes in his var. *incana* Hillebrand's var. α , β , and ϵ , which are all very closely related to be sure, but still distinct enough to be ranked as varieties. No. 12613 is the typical var. *incana*.

It is true that the validity of this variety is a little doubtful, as it seems to



Showing leaf variation in the var. **incana**, the most common variety on Hawaii. Each leaf is from a different specimen and different locality.



Metrosideros collina (Forster) Gray Subsp. *polymorpha* (Gaud.) var. *incana* forma *lurida* Rock.

merge into var. *a typica*; it may be only a form of the latter, which differs from it in the heart-shaped, shortly-petioled, orbicular leaves.

The typical *Metrosideros collina* from Fiji, Society Islands, Tahiti and Kermadec Island, which does not at all differ in the localities mentioned above, and which is otherwise known as *Metrosideros villosa* Sm. is almost identical with the Hawaiian var. *incana*, if identical at all with any of the Hawaiian forms. The only difference is apparently the sessile flowers; in the Hawaiian var. *incana* the flowers are almost subsessile, the pedicels ranging from 1-5 mm.

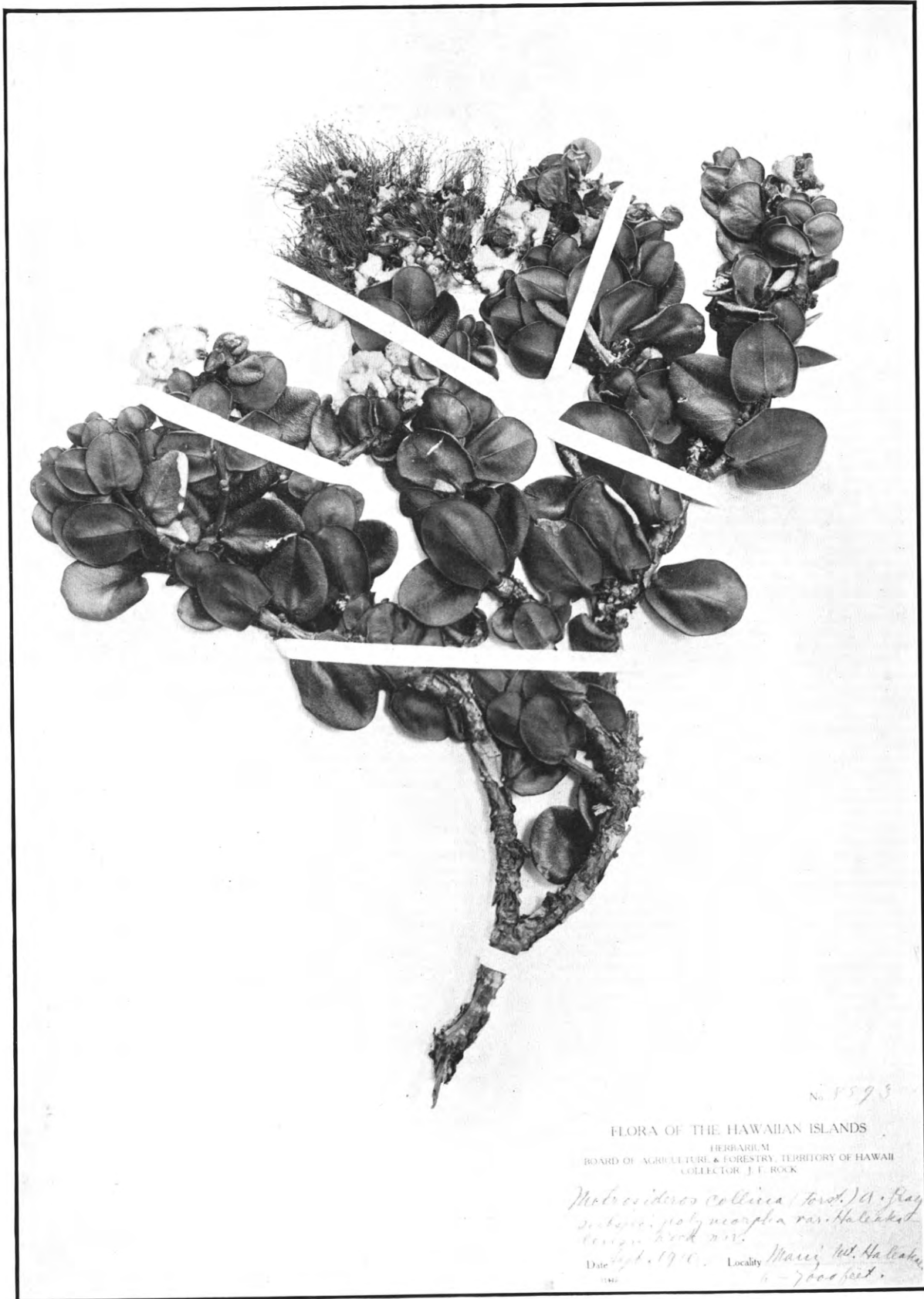
***Metrosideros collina* (Forster) A. Gray subsp. *polymorpha* (Gaud.)
var. *incana* (Lévl.) forma *lurida* Rock n. f.**

A medium-sized tree, with robust branches and tomentose branchlets; leaves ovate to suborbicular, yellowish green, with a dull grayish tomentum on both surfaces when young, but soon glabrate with the exception of the petioles and lower portion of midrib, bluntly acute or rounded at the apex, truncate or cordate at the base, thick coriaceous with a distinct intramarginal nerve about 2 mm. distant from the margin and arising from the second pair of lateral nerves at the base of the leaf, 3-5 cm. long, 2-3.5 cm. wide, on stout petioles of about 5 mm.; inflorescence a many flowered, densely white-woolly cyme; calyx densely white villous including the acute lobes, petals and stamens sulphur-yellow turning brownish when dry, petals covered with a glandular pubescence, the margins whitish ciliate; stamens 2 cm.; style as long or little shorter; capsule not known.

MOLOKAI: In dry gulches above Kamolo, leeward side, in company with *Reynoldsia sandwicensis*, *Dracaena aurea*, *Nothocestrum latifolium*, and other sub-xerophytic vegetation, flowering April, 1910, Rock, No. 7021 in College of Hawaii Herbarium.

This yellow-flowered *Metrosideros* must be regarded as a form of var. *incana*, with which it has the tomentose leaves in common. The tomentum becomes deciduous at the maturity of the leaves; the latter are ovate and often cordate at the base. It is, however, mainly distinguished from var. *incana* by the large flowered cyme and sulphur yellow petals and stamens. It is a robust form inhabiting the dry rocky regions of Kamolo on the lee side of Molokai.

This is the form mentioned in the writer's Indigenous Trees of the Hawaiian Islands on page 331, under var. *θ* beginning with the fourth line of description from above "here also belongs a form," etc.



Metrosideros collina (Forster) A. Gray subspee. **polymorpha** (Gaud.) var. **Haleakalensis** Rock.

***Metrosideros collina* (Forster) A. Gray subsp. *polymorpha* var. *Haleakalensis* Rock n. v.**

Metrosideros polymorpha Gaud. var. η Rock in Indig. Trees Haw. Isl. 331, Pl. 127. 1913.

A tree 8-10 m. tall, freely branching, the branches rather brittle, stiff and stout; leaves thick, coriaceous, suborbicular to ovoid or obovoid, cordate at the base, rounded or slightly emarginate at the apex, sessile, or shortly petiolate, perfectly glabrous on both sides, even when young, shining above, dull underneath, midrib prominent, the leaf-margin induplicate; cymes short, contracted, densely woolly; peduncle short; pedicels about 3 mm.; calyx densely white tomentose, the lobes green, glabrous; petals bright red, with white ciliate margins, rounded; stamens 2 cm., style exserted; capsule of a dirty gray, tomentose, large, 1 cm. in diameter.

MAUI: In gulches back of Puunianiau Crater, slopes of Mt. Haleakala, elevation 6500-7000 feet, flowering Oct., 1910, Rock, type No. 8593 in the College of Hawaii Herbarium.

A very handsome and distinct variety, reaching a height of 25 to 30 feet, with stiff, stout branches; it would come close to *a typica*, but differs from it in the thick, coriaceous, perfectly glabrous leaves and large flowers and capsules. It is near to Gray's var. γ , but differs from it in the densely woolly inflorescence and the large fruits. It does not belong to Hillebrand's var. δ , as he states: "glabrate in all parts"; but his specimen marked δ in the Gray Herbarium has a woolly inflorescence and, owing to the leaves, which are different from those of var. *Haleakalensis*, must be referred to the writer's var. *Newellii* Rock. Var. *Haleakalensis* is var. η , plate 127 in the Indigenous Trees of the Hawaiian Islands.

Gray's var. γ from the upper slopes (8000 feet) of Mauna Loa, Hawaii, (in the Gray Herbarium), while glabrous in all parts, will probably have to be referred to this variety, although the capsule is smaller and glabrous, the leaves are identical with var. *Haleakalensis*. It is possible that the capsules are quite old and have lost their tomentum. As the specimen in the Gray Herbarium is quite fragmentary, the question cannot be decided definitely.

This variety grows in company with *Raillardia Menziesii*, *Rubus*, *Lobelia*, *Argyroxiphium virescens* and *A. sandwicense* D.C. var. *macrocephalum*. It has apparently not been collected previously.



Metrosideros collina (Forster) A. Gray subsp. **polymorpha** (Gaud.) var. **macrophylla** Rock n. v.

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.)
var. *macrophylla* Rock, n. v.**

A small tree 3-5 m. high, often bushy, with light brown terete branches and squamaceous bark; leaves large, thick coriaceous, bright green, glossy, shining above, dull underneath, with strong stout midrib, ovate in outline, obtuse at the apex, truncate or rounded at the base, or oblong and slightly acute at the apex, 8-12 cm. long, 5-8 cm. broad, on petioles of 10-18 mm.; cymes large, many flowered; flowers large, on pedicels of 4-6 mm.; calyx 6 mm., silky canescent, the lobes acute, deltoid, 3 mm., either pruinose or pubescent to glabrous; petals large dark red, 5 mm., rounded; stamens 25 mm. long, style as long; capsule large, resembling *M. macropus*, silky canescent, almost included in the calyx tube, 8 mm. high.

HAWAII: Along the Volcano Road between Olaa and Mountain View, elevation about 1200-1500 feet, in wet forest, flowering and fruiting April 20-24, 1916, Rock, type 12630 in College of Hawaii Herbarium; other numbers collected, 12631 and 12632, belong here.

Var. *macrophylla* is an exceedingly handsome plant and very beautiful when in full flower. It is a small tree or shrub, and inhabits the wet forests of Olaa, Hawaii. It differs from all the other varieties in the exceedingly large leaves, flowers and capsules, but comes, otherwise, close to *M. collina polymorpha* var. *Newellii* of the low lands near Hilo.

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.)
var. *Newellii* Rock n. v.**

Metrosideros polymorpha Gaud. var. δ A. Gray, U. S. E. E., 562. 1854.

A shrub or small tree 4-8 m. high, with terete branches; leaves elliptical oblong to ovate, subcoriaceous, obtuse or acute at both ends, or slightly emarginate at the apex, glabrous on both sides, shining above, dull underneath, dark green, 4-7 cm. long, 2-3 cm. wide, on petioles of 6-10 mm., intramarginal nerve distinct, close to the margin; cyme small, densely white-woolly-tomentose; flowers small red, calyx white woolly, as well as calycine lobes, but occasionally glabrous; petals glabrous, slightly ciliate at the margins; stamens 22 mm., style as long or exserted; capsule small, dark gray and woolly, very much exserted from calycine tube.

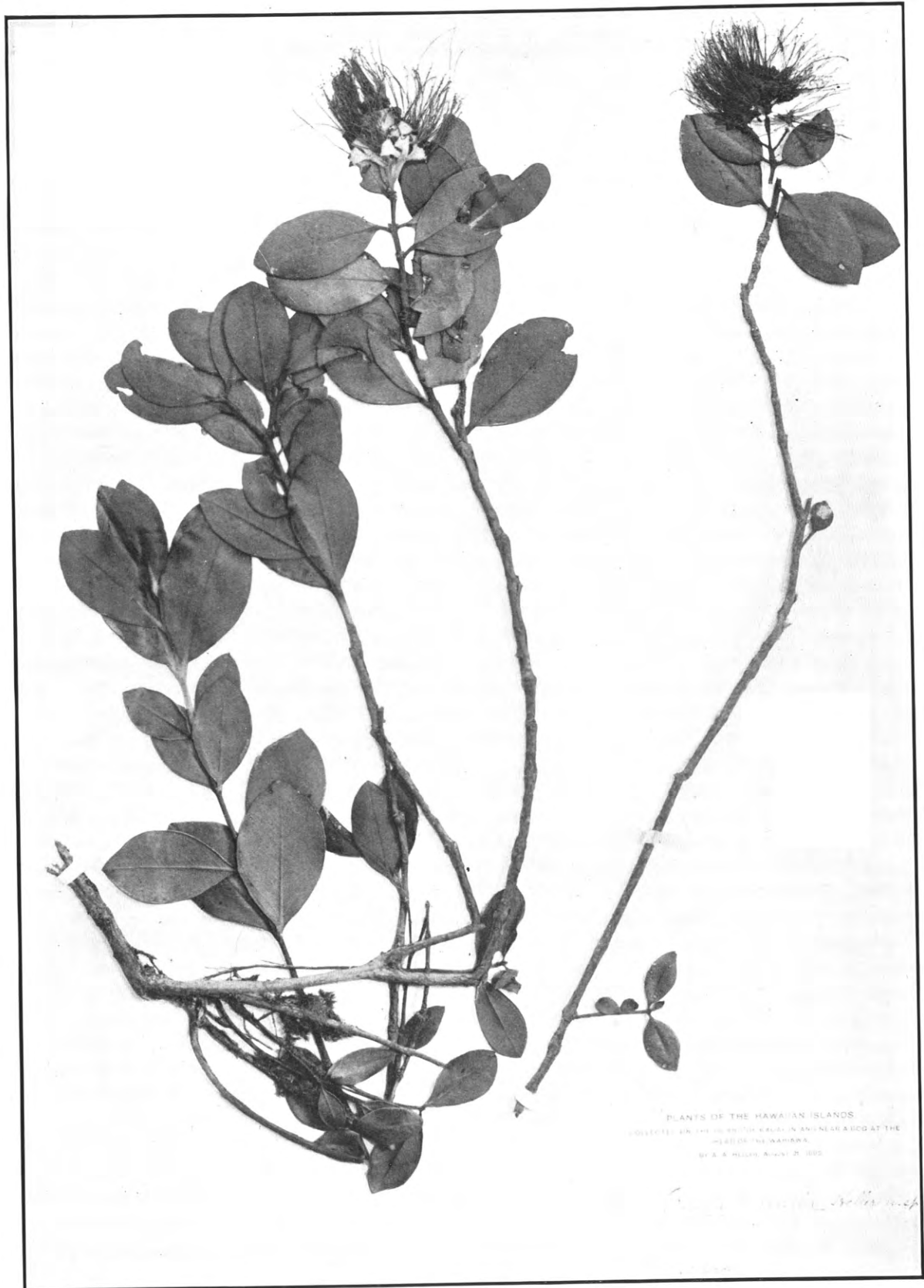
HAWAII: Piihonua gulch, back of Hilo, flowering and fruiting, Feb., 1916, Brother Mathias Newell, Nos. 12625, 12626, 12627, 12628;—Piuhonua gulch, flowering April 24, 1916, Rock, No. 12633 in College of Hawaii Herbarium;—Rainbow Falls, back of Hilo, flowering April 24, 1916, Rock, No. 12634 in College of Hawaii Herbarium.

This variety the writer named in honor of Bro. Mathias Newell of Hilo, who supplied him with material of several varieties of *Metrosideors*, and who took a keen interest in the work of straightening out the various forms of the Hawaiian *Olias*. Var. *Newellii* is intermediate between var. *glaberrima* and var. *incana*. It differs from both of the latter varieties in having perfectly glabrous leaves and a woolly inflorescence, which fact brings it into the same category with var. *macrophylla*, which has the same characters in common with var. *Newellii*, but differs from it in the very large leaves, flowers and capsules, and in the latter being included in the calyx tube, while those of var. *Newellii* are very much exserted.

To this variety belongs Asa Gray's var. δ ; Hillebrand is uncertain about this variety and refers it to γ or δ , but his var. δ is supposed to have a glabrous inflorescence. There is one specimen of this variety in the U. S. National Herbarium, No. 49427 ex Coll. U. S. Expl. Expedition.



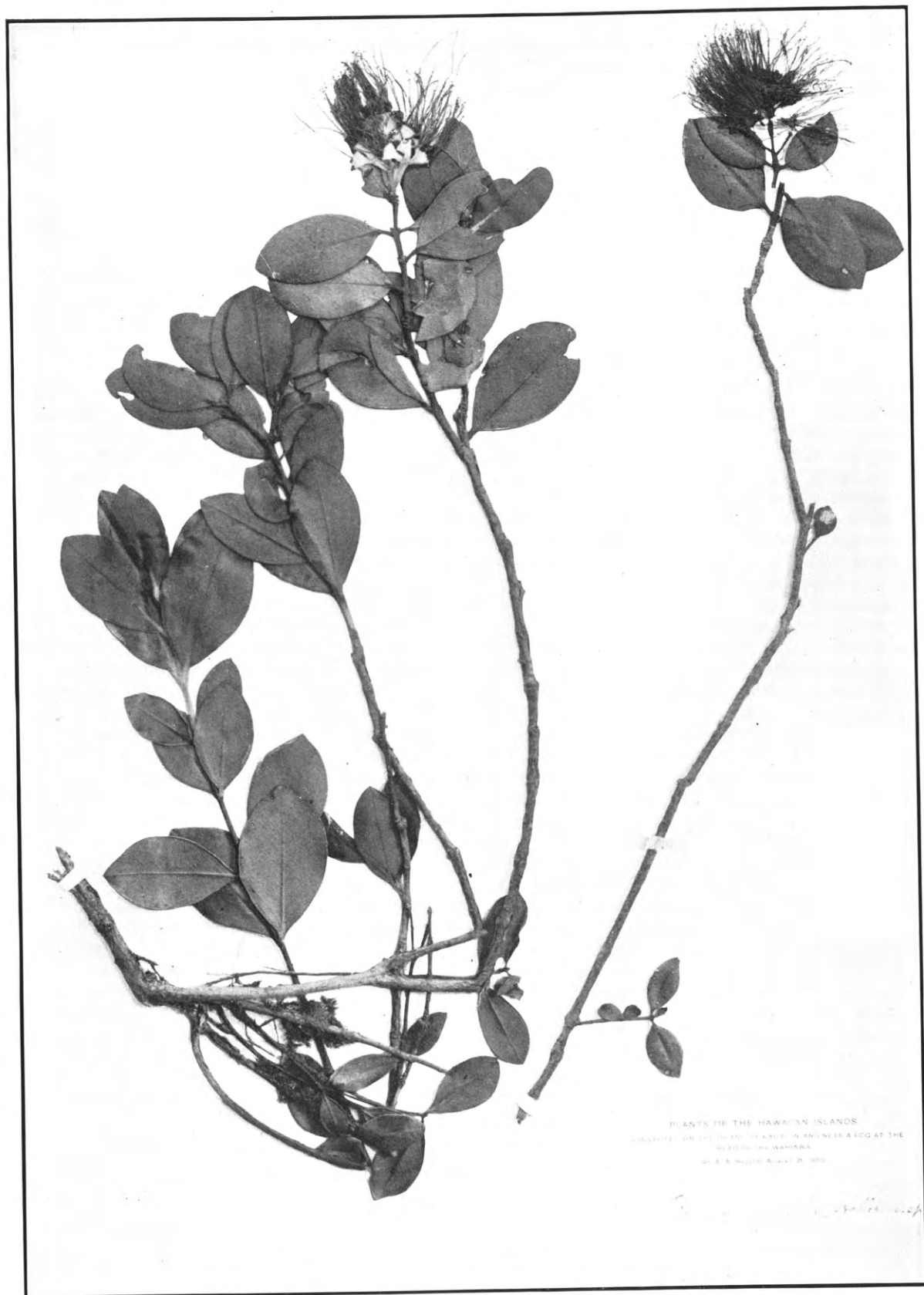
Metrosideros collina (F.) A. Gray subsp. *polymorpha* (Gaud.) var. *Newellii* Rock.



PLANTS OF THE HAWAIIAN ISLANDS
COLLECTED ON THE ISLAND OF KAUAI, IN A NEAR A BCG AT THE
HEAD OF THE WAIKANA
BY A. R. HELLER, AUGUST 21, 1905

Metrosideros collina Heller n. sp.

Metrosideros collina (Forster) A. Gray subsp. *polymorpha* (Gaud.) var. *pumila* (Heller) Rock.



Metrosideros collina (Forster) A. Gray subsp. *polymorpha* (Gaud.) var. *pumila* (Heller) Rock.

Metrosideros collina (Forster) A. Gray, subspec. **polymorpha** (Gaud.)
var. **pumila** (Heller) Rock.

Nani(a) pumila Heller in Minnes. Bot. Stud. IX: 864, Pl. 55. 1897.

Nania polymorpha Gaud. var. *glaberrima* Lévl. in part, in Fedde Repert. Spec. Nov. X: 149. 1911.

*A bush, 3 dm.-6 dm. high, either simple or sending out one or two ascending branches; outer bark gray, peeling off in shreds; leaves (orbicular?), broadly ovate, or sometimes obovate, the largest about 5 cm. in diameter, thick glabrous, light green and shining above, dull and glandular underneath, the margin lightly induplicate, midrib impressed above, prominent beneath; petioles stout about 6 mm. long; fully developed cymes large, with densely woolly peduncles 2.5 cm. in length; calyx very woolly, except the short, triangular lobes, which are almost glabrous, but glandular; petals red, broadly obovate, about 6 mm. in length, glandular on the outside, ciliate; stamens numerous 2.5 cm. long, dark red; style almost as long, not enlarged at the stigmatose apex; ovary deeply immersed in the bottom of the calyx, its disk-like top very glandular and resinous.

KAUAI: On and near the bog at the head of the Wahiawa River, at an elevation of 3000 feet, flowering Aug. 21, 1895, Heller, type No. 2738 in Gray Herbarium.

The writer has not collected this variety, which seems quite distinct from the other swampy forms found on Kauai, Molokai, Maui and Hawaii. Heller, in his description, says orbicular, the writer enclosed the word in the parenthesis and placed a query mark after it. The leaves in Heller's plate in the type number are not orbicular, but ovate, and tapering at the base and are perfectly glabrous.

In the swamps of Lehua makanoe and Alakai occurs a form with orbicular or ovate leaves which are woolly underneath and were placed by the writer with var. *incana*. Heller's statement that his *pumila* is also confined to the large bog on the plateau above Waimea, is incorrect. The low form which occurs in that bog belongs to var. *incana*. Not even the variety found at the summit of Wai aleale, Kauai, has anything in common with variety *pumila*.

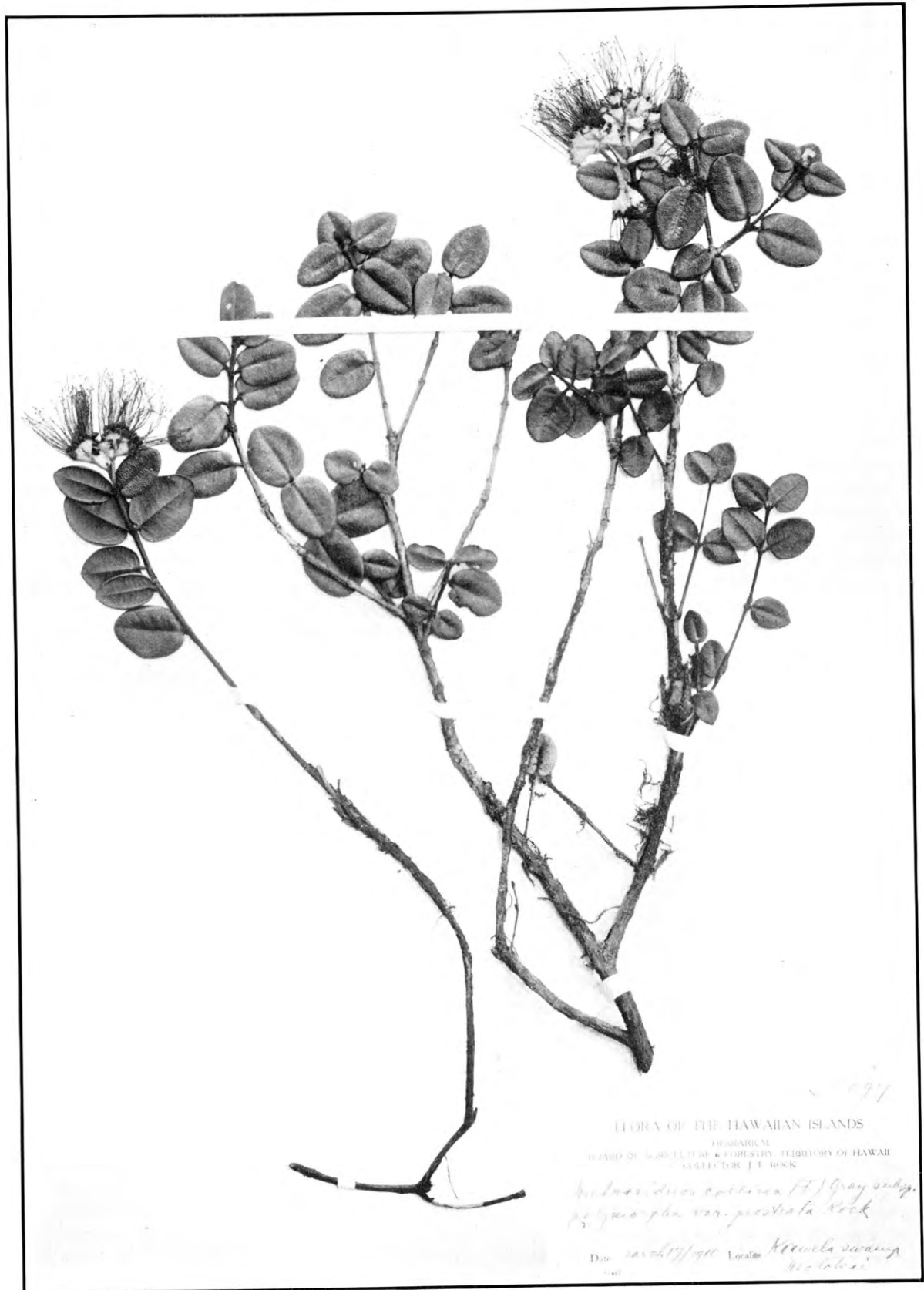
Metrosideros collina (Forster) A. Gray subspec. **polymorpha** var.
prostrata Rock.

Metrosideros polymorpha Gaud. var. γ Hbd. Flora Haw. Isl. 126. 1888.

Metrosideros polymorpha Gaud. var. α et ϵ Rock, Indig. Trees Haw. Isl. 327. 1913.

Plant prostrate, trailing, 10-30 cm. high, or entirely prostrate and 1-2 m. long, branches and branchlets quadrangular, the latter reddish, leaves as in variety α *typica*, though smaller except in the Kauai specimen, 15 mm.14 cm. long, 10 mm.3 cm. wide, suborbicular to ovate, cordate to subcordate to rounded at the base, bluntly acute or rounded at the apex, coriaceous, glabrous on both sides (with the exception of the Waialeale, Kauai, specimens, which are slightly pubescent above when young), shining above, dull underneath, the margins slightly induplicate, midrib prominent underneath, intramarginal nerve indistinct or arched and uniting the lateral veins; cymes few flowered, white woolly, or glabrous when older, or slightly silvery canescent; calyx woolly with the exception of the calycine lobes; petals red as well as the stamens, the former with whitish ciliate margins; stamens 2-2.5 cm. long, style as long or longer; capsule not known.

*Heller's original description is here quoted, only part of the measurements have been changed into the metric system, and description which belongs to generic character omitted.



Metrosideros collina (Forster) Gray, subsp. **polymorpha** (Gaud.) var. **prostrata** Rock.



Metrosideros collina (Forster) Gray subspec. **polymorpha** (Gaud.) var. **prostrata** forma **strigosa** Rock

KAUAI: Summit swamp of Mt. Waialeale, elevation 500-5200 feet, flowering Sept. 24, 1909, in company with *Dubautia Waialealae*, *Geranium humile*, var. *kauaiense*, *Drosera longifolia*, *Oreobolus furcatus*, *Sanicula*, etc., Rock, No. 5087 in College of Hawaii Herbarium.

MOLOKAI: Kawela swamps back of Kamoku, flowering March 17, 1910, in company with *Astelia*, *Viola mauiensis*, *Styphelia*, etc., Rock, No. 6097 in College of Hawaii Herbarium.

MAUI: In the bogs on the top of Eeka, Hillebrand, in Berlin and Gray Herbarium;—summit of Mt. Puukukui, West Maui, elevation 5800 feet, flowering Aug., 1910, in company with *Sanicula*, *Acaena glauca*, *Viola mauiensis*, *Wilkesia grayana*, *Geranium humile*, Rock, No. 8145 in the College of Hawaii Herbarium.

This variety is quite distinct from Heller's var. *pumila*, and is identical with Hillebrand's var. γ from West Maui. The specimens from Waialeale, Kauai, may be looked upon as an intermediate between var. *prostrata* and *pumila*, though the latter has no prostrate habit, which may, however, be due to the lower elevation.

Var. *prostrata* occurs on Kauai, Molokai and Maui, while a very strigosely hispid form of it can be found on the summit swamp of the Kohala Mountains on Hawaii. The specimens from the West Maui Puu Kukui swamp has glabrous cymes, which fact accounted for the writer's separating it from the others in his treatise on that genus in the Indigenous Trees of the Hawaiian Islands, and his placing it in the section *glabrae* var. *a*.

The West Maui and Molokai specimens are practically identical, while the Kauai specimens differ slightly, and that only in the leaves, which in the latter have a slightly tomentose midrib. The tomentum on the cyme cannot be relied upon in this variety, as I have found densely woolly inflorescences and only fine silky-canescens ones on the same plant. Hillebrand's specimen of his var. γ in the Gray Herbarium is only slightly tomentose, while he says in his description "woolly-tomentose."

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.) var. *prostrata* forma *strigosa* Rock.**

Metrosideros polymorpha Gaud. var. κ Rock, Indig. Trees, Haw. Isl. 331. 1913.

Plant small, prostrate, about 20 cm. in length; leaves orbicular, or obcordate, broadest at the apex, cordate at the base and often subcordate at the apex, or deeply marginate, 15-20 mm. in diameter, glabrous above when old, covered with a grayish tomentum when young, densely strigose with yellowish hair underneath, coriaceous, the margins induplicate, petioles very short 1-2 mm.; cyme very short, few flowered, densely villous; calyx and calycine lobes as well as ovary villous; petals red, pubescent outside; stamens red, 2 cm. long, style as long, stigma pubescent; capsule unknown.

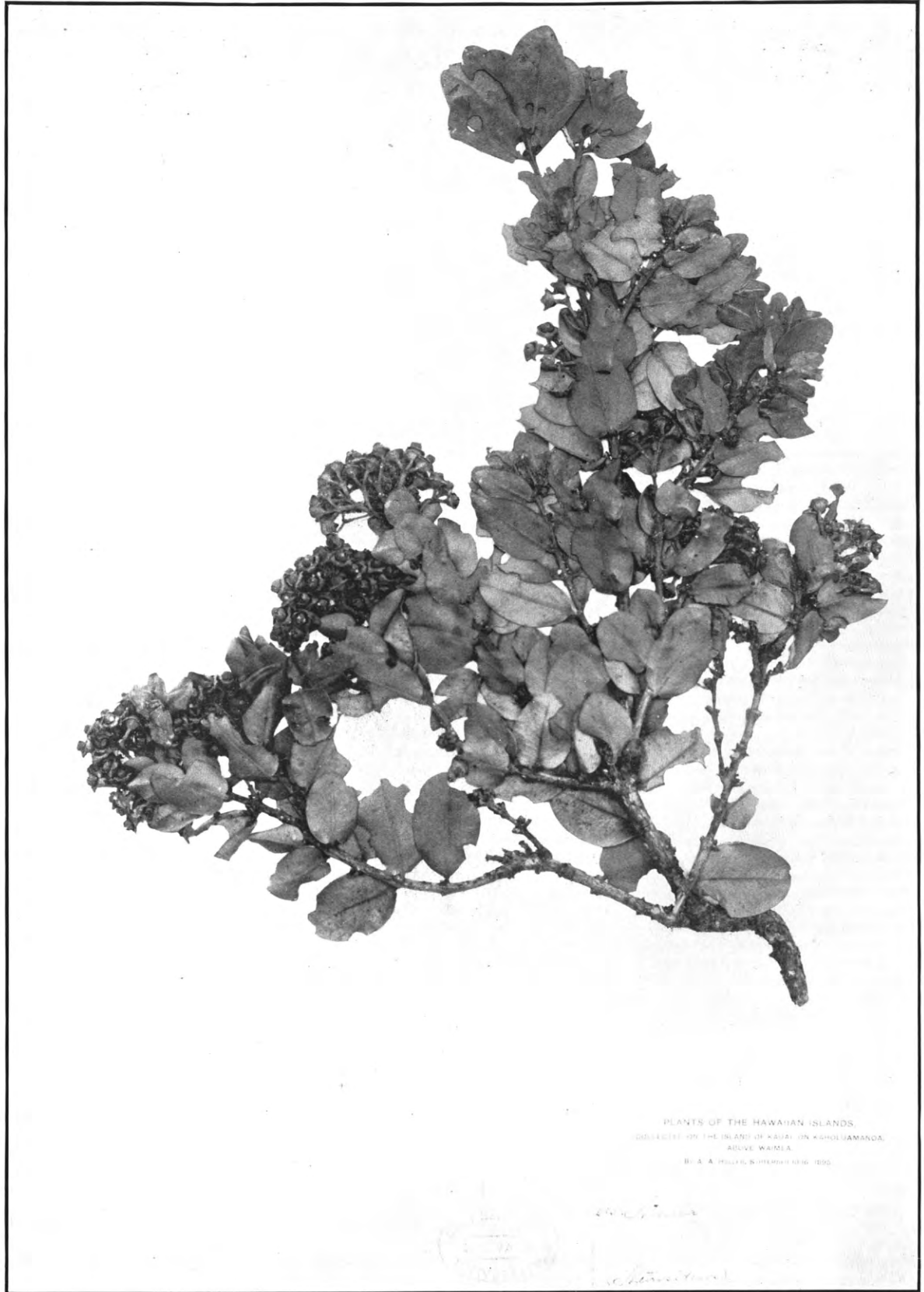
HAWAII: In bog on summit of Kohala Mountains in company with *Viola mauiensis* var. *Kohalana*, *Selaginella deflexa*, etc., flowering June, 1910, Rock, No. 8414 type in College of Hawaii Herbarium.

An interesting form of var. *prostrata* differing from it in the obcordate sessile leaves, which are densely strigose underneath. It is peculiar to the summit of the Kohala Mountains, where it grows prostrate in the open bog which harbors a similar vegetation to that of Puu Kukui, Maui and Waialeale of Kauai.

NOTE.—The Kauai plants inhabit open spots of bright red (oxidized) soil or clay, which the natives of bygone days employed for painting their canoes and other objects.



Metrosideros collina (Forster) Gray subsp. **polymorpha** (Gaud.) var. **Fauriei** (Levl.) Rock.



Metrosideros collina (Forster) A. Gray subspecies **polymorpha** (Gaud.) var. **glabrifolia** (Heller) Rock.

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.)
var. *Fauriei* (Lévl.) Rock.**

x *Nania* (*Metrosideros*) *Fauriei* Lévl. in Fedde Repert. spec. nov. X: 150. 1911.

A medium-sized tree about 10 m. or less high, many branched; branches terete, branchlets slightly quadrangular, glabrous, reddish; leaves linear-oblong, bluntly acute or obtuse at both ends, light green, with reddish midrib, resembling *M. tremuloides*, thick coriaceous, dull on both sides, 4-7 cm. long, 1-2.5 cm. wide, on rather long petioles of 1-2 cm.; inflorescence a many-flowered cyme, silky canescent or woolly; calyx woolly or subglabrous, the acute lobes glabrous; petals red, minutely ciliate on the margins; stamens about 2 cm., style exserted 2.5 cm. in length, capsule glabrous, rather large, almost entirely hidden in the calyx.

MOLOKAI: Kamalo, June, 1910, U. Faurie;—middle ridge of Mapulehu, elevation 1500 feet, flowering Dec. 28, 1915, Rock and Copeland, No. 12524 in College of Hawaii Herbarium.

This variety, which was described or rather mentioned as a hybrid of *M. polymorpha* and *M. macropus* by H. Lévillé, has only the rather long petioles in common with the latter species; to be more correct the petioles, which are rather long for a variety of the subspecies *polymorpha*, approach in length those of *M. macropus*. In shape of leaf it comes close to *M. tremuloides*, and var. *glaberrima* of *polymorpha*, but differs from either in the woolly inflorescence. The included capsule (in calyx) and the rather long petioles, are responsible for Lévillé's placing it as a hybrid of *M. macropus*; however, in the latter species the petioles are much longer and the inflorescence is evolved from a scaly bud, the scales remaining persistent. In var. *Fauriei* small scales are noticeable, but are attached at the base of the calyx only and become soon deciduous. The scales in *M. macropus* are not at the base of the calyx, but at the base of the pedicels and at the base of a foliose flower bearing branchlet. This factor throws var. *Fauriei* out of possible varietal rank of *Metrosideros macropus*. It grows on open grassy slopes on the lower ridges on the leeward side of Molokai in company with var. *glaberrima*.

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.)
var. *glabrifolia* (Heller) Rock.**

Nani(a) glabrifolia Heller in Minnes. Bot. Stud. IX: 866: 1897.

*A large tree 10-14 m. in height, with a trunk diameter of 6.5 dm.-1.6 m.; main branches stout and spreading, young branches crowded, angled, with short internodes; leaves numerous, broadly ovate, usually cordate at the base on very short petioles, glabrous; the short, stout, peduncles and pedicels as well as the calyx shortly pubescent, but not woolly; fruit three-fourths free; flowers bright red.

KAUAI: On the high plateau of Waimea, Kaholuamano, elevation 4000 feet, fruiting Sept. 10-16, 1895, Heller, type No. 2821.

This variety was not collected by the author; it is quite distinct and comes probably close to var. *glaberrima* (Lévl.) Rock, but differs from it in the small ovate-cordate leaves and stout branches. The leaves would remind one of var. γ of Gray, but are not so thick in texture.

*Heller's original description is quoted, only the measurements have been changed into the metric system.



Metrosideros collina (Forster) Gray subsp. **polymorpha** (Gaud.) var. **glaberrima** Levl.

***Metrosideros collina* (Forster) Gray subsp. *polymorpha* (Gaud.) var. *glaberrima* (Lévl.) Rock.**

- Metrosideros polymorpha* Gaud. Bot. Voy. Uranie, 482, Pl. 109. 1826.
Metrosideros polymorpha Gaud. var. ζ Gray in part.
Metrosideros polymorpha Gaud. var. γ et var. *lutea* H. Mann in Proc. Am. Acad. VII: 166. 1866.
Metrosideros polymorpha Gaud. var. 2, 5 et 7 *lutea* H. Mann in Proc. Ess. Inst. 5: 243-244. 1868.
Metrosideros polymorpha Gaud. var. ζ Hbd. Flora Haw. Isl. 127. 1888.
Nani(a) lutea Heller (not A. Gray) in Minnes. Bot. Stud. IX: 867. 1897.
Nania polymorpha Gaud. var. *glaberrima* (Lévl.) in Fedde Repert. Spec. nov. X: 149. 1911.
Metrosideros polymorpha Gaud. var. γ Rock, Indig. Trees Haw. Isl. 327. 1913.

Medium-sized or tall trees 10-15 m. high, perfectly glabrous in all parts, branches and branchlets terete; leaves ovate, elliptic, oblong, or obovate, rounded, obtuse or acute at both ends, chartaceous to coriaceous, glabrous on both sides, 3.5-7.5 cm. long, 1.5-3.5 cm. wide, on petioles of 3-10 mm., intramarginal nerve distinct in the larger leaved specimens; cyme perfectly glabrous, many and large flowered, calyx glabrous as well as calycine lobes and petals, the former thin with reddish, thinner margins, the latter oblong, red to salmon-pink, usually not ciliate on the margins or only slightly so, capsules glabrous.

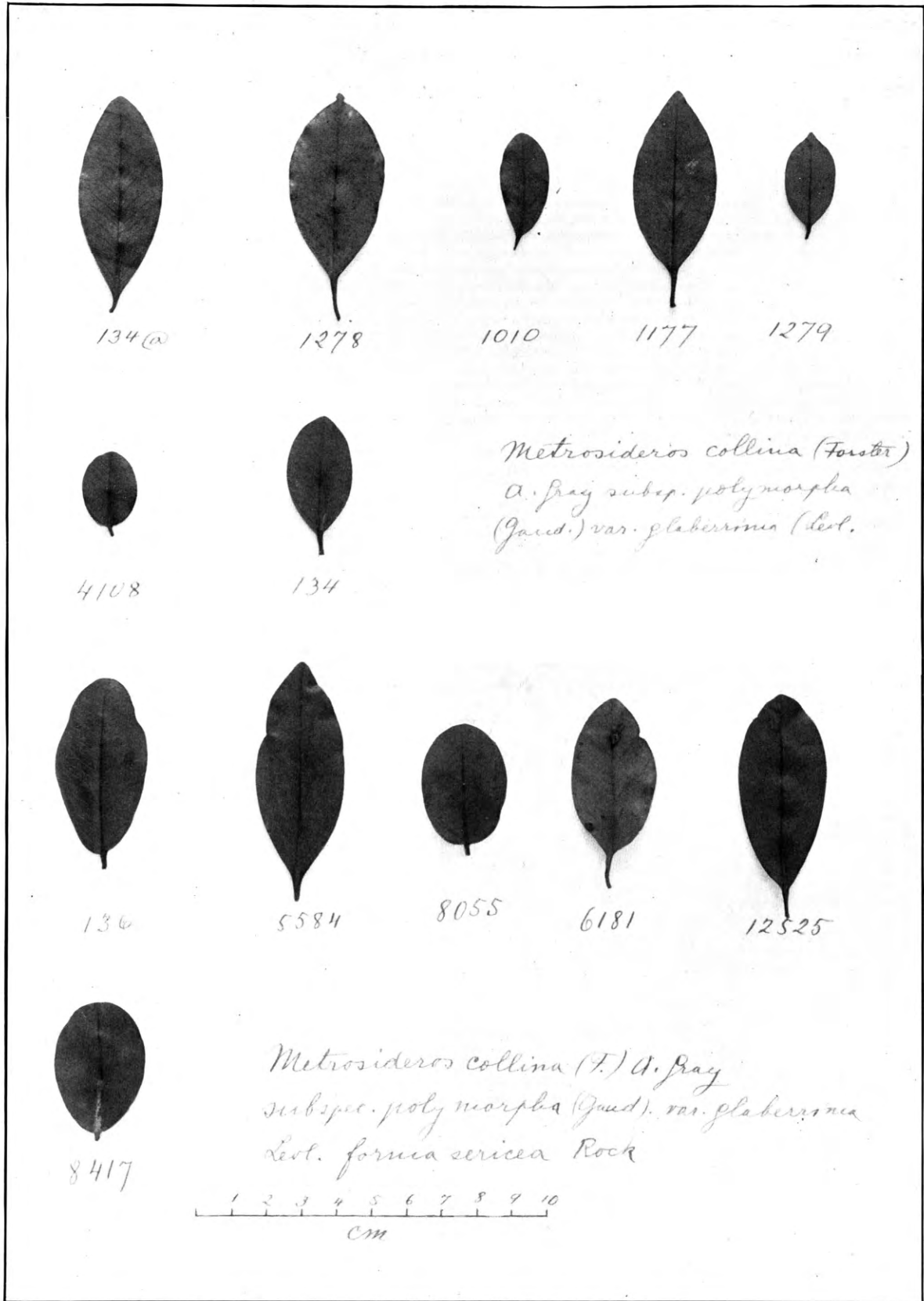
OAHU: Woahoo, Ins. Sandwich, Maio, 1825, Macrae, in Gray Herbarium;—Gaud. Voy. Bonite, in Gray Herbarium;—U. S. Expl. Exped. 1838-42, in Gray Herbarium;—Oahu, Mann and Brigham, 96 in U. S. National Herbarium, No. 49433;—lower slopes of Konahuanui, above Manoa, flowering April 25, 1895, Heller, No. 2219 in Gray Herbarium;—Waianu Valley, near Waiahole, flowering Jan. 22, 1909, Rock, No. 1177;—Mts. of Wahiawa, flowering July, 1908, No. 134 in the College of Hawaii Herbarium;—Konahuanui trail, flowering Jan. 7, 1909, No. 1010;—Waikane Mts., windward side, flowering Jan. 23, 1909, No. 1278, College of Hawaii Herbarium;—Kaliuwaa Valley, flowering Aug. 15, 1908, No. 134 in College of Hawaii Herbarium.

KAUAI: Along the Hanapepe River near the falls, flowering July 2-8, 1895, Heller, No. 2484 in Gray Herbarium, and U. S. National Herbarium No. 265134.

HAWAII: Woods above Waimea, wet forests, flowering July 9, 1909, Rock, No. 4108 in College of Hawaii Herbarium.

This is one of the most commonly-met-with varieties on Oahu, while on Hawaii the woolly forms are more common. This variety embraces various leaf forms from ovate and rounded to oblong and acute forms; only in the very young flower buds can there be a fine silkiness detected, the mature flowers are, however, perfectly glabrous. The pruinose form (*sericea*) seems to be a transition type leading to var. *Newellii* from Hilo, Hawaii, while the very glabrous form with small leaves leans towards *M. tremuloides*. On Oahu this tree grows straight with erect main bole when in open stands, and reaches a height of 40-45 feet, but when growing on ridges and in forests with other trees has a short trunk branching several times a few feet above the ground.

Var. *glaberrima* is Gaudichaud's plate 109, Bot. Voy. Uranie. To it be-



Leaf variation of variety **glaberrima** and its form **sericea**.

longs Mann and Brigham's No. 212 from Oahu, marked *M. polymorpha* var. *lutea*. A collector by the name of Mathews gathered a specimen in the Society Islands in 1830, No. 50, which he describes as a shrub 5 feet in height growing on high hills, seems to belong to forma *sericea* of this variety or, which is more likely, to *Metrosideros collina* var. γ *vitiensis*, regarding which see under forma *sericea*. A. Gray's var. *glaberrima* of *Metrosideros collina* certainly seems, or rather is, exceedingly close to var. *glaberrima* of its subspecies *polymorpha*, for even the fruits which are supposed to be sessile in *M. collina* are distinctly pedicellate in his specimen.

In the Society Islands, or the South Pacific Islands as a whole, there seems to be much less variation in the species than in the Hawaiian subspecies, various forms of which seem to link varieties of the species *collina* together. *Metrosideros collina* var. *villosa* (*M. villosa*) from Fiji is absolutely identical with plants from Tahiti. In the latter island there are apparently only three or four forms: 1. *glaberrima*, a perfectly glabrous form close to *glaberrima* of the subspecies *polymorpha*; 2. a pruinose form (var. γ *vitiensis*) close to forma *sericea* of the Hawaiian var. *glaberrima*; 3. var. *a villosa*, the typical *M. collina* which is close to our var. *incana*. There is a fourth variety of Seeman (No. 171) from Fiji which is exceedingly close to *M. tremuloides* of Oahu, Hawaii.

All the other remaining varieties and forms described from Hawaii are peculiar to the group, and have apparently no affinities to South Sea Island forms of *M. collina*, on which fact our subspecies *polymorpha* is based. The very small leaved specimens of this variety are almost sufficiently distinct to make it a form of var. *glaberrima* (Lévl.) Rock.

***Metrosideros collina* (Forster) A. Gray, subspec. *polymorpha* (Gaud.)
var. *glaberrima* (Lévl.) forma *sericea* Rock.**

Metrosideros polymorpha Gaud. var. ϵ A. Gray. U. S. E. E. 563. 1854.

Metrosideros polymorpha Gaud. var. δ Hbd. in part. Flora Haw. Isl. 126. 1888.

Metrosideros polymorpha Gaud. var. δ Rock (non. Hbd.) et θ Rock in Indig. Trees Haw. Isl. 327 et 331. 1913.

Medium-sized trees with angular or slightly flattened reddish branchlets, leaves ovate, elliptical, or ovate-oblong, bluntly acute or rounded at both ends or subcordate at base, dull or glossy on both sides, glabrous, or the midrib slightly tomentose underneath (only in No. 8417 from Hawaii), intramarginal nerve distinct, arising from the second lateral pair at the base, chartaceous to coriaceous, 3-7 cm. long, 1.5-3.5 cm. wide, on petioles of 2-6 mm.; cyme short and few-flowered to open and many-flowered, pruinose to slightly silky, silvery pubescent, ultimate pedicels varying from 1.5-3 mm.; calyx pruinose or silky canescent, excepting the obtuse lobes; petals and stamens from pink and salmon colored to deep red, the petals glabrous; capsule pruinose, exserted.

KAUAI: Between the Hanapepe and Wahiawa rivers, flowering June 22-Aug. 24, 1895, Heller, Nos. 2762, 2690, 2417 in Gray Herbarium;—on the trail to Waialae Falls, Kaholuamano, elevation 3400 feet, flowering Sept., 1909, Rock, No. 5584 in College of Hawaii Herbarium.

OAHU: In the mountains behind Honolulu and Waianae, U. S. E. E.;—Wahiawa, north fork of Kaukonahua gulch, flowering May 15, 1909, Rock, No. 136 in College of Hawaii Herbarium;—along Tantalus, flowering April 2, 1895, A. A. Heller, No. 2053, in the U. S. Nat. Herb. No. 262854.



Metrosideros collina polymorpha var. *glaberrima*.
Trunk of the glabrous form of **Ohia Lehua**, growing on Kauai,
Kaholuamano, elevation 3600 feet.

MOLOKAI: Mapulehu ridge, flowering Dec. 28, 1915, Rock, No. 12525 in College of Hawaii Herbarium, and Waiau Valley, March 28, 1910, No. 6181 in College of Hawaii Herbarium.
 LANAI: Mahana ridge, flowering July 22, 1910, Rock, No. 8055.
 HAWAII: Byron Bay, July, 1825, Macrae, in Gray Herbarium;—mountains of Mauna Loa?, Hbd.;—lowlands of Kohala, flowering June, 1910, Rock, No. 8417 in College of Hawaii Herbarium.

The form *sericea* of var. *glaberrima* is identical with Asa Gray's var. ϵ and Macrae's var. ϵ , and is in part Hillebrand's var. δ and ζ . It also includes the writer's variety δ from Molokai, and var. θ from Lanai. This form differs mainly from var. *glaberrima* in the pruinose or silky canescent cyme and calyx. It is almost identical with Asa Gray's *Metrosideros collina* var. γ *vitiensis* of which he says: "*ramulis foliisque ellipticis oblongisve glabris; inflorescentia calycibusque plus minus cano-sericeis; floribus nunc subpedicellatis.*" He further says in his discussion: "Flowers sessile or nearly so, etc., which distinguishes the plant from the Sandwich Islands." The writer has in his possession plants from the Island of Hawaii which have pedicels shorter than those in var. γ *vitiensis* of Asa Gray, and again, there is a specimen from Fiji collected by W. H. Harvey in Nov., 1885, in the Gray Herbarium which A. Gray must have seen, which has glabrous leaves and a woolly inflorescence and which has pedicels 4 mm. long, also as long as, and longer than those found in Hawaiian specimens. Were it not for avoiding confusion, and for the fact that this plant, strangely identical with a Fijian variety, is simply a form of a very polymorphous subspecies of *Metrosideros collina*, which links together a large number of varieties, and which in itself is again represented by numerous subforms which cannot be separately enumerated, but are included in the general description, the writer would unite it with Gray's var. γ *vitiensis*, which is merely one of three varieties of the *Metrosideros collina* occurring in Fiji.

Strangely, Asa Gray laid too much stress on the length of pedicels, which are sometimes wanting, or oftener wanting than present, but are nevertheless very distinct, and as already mentioned, are 4 mm. long in some Fijian material; he had a splendid opportunity to save confusion in taxonomy and could have straightened out this perplexing species.

The only possible difference between the Hawaiian forma *sericea* and var. γ *vitiensis* from Fiji is the size of the flower, which is a little smaller in the Fijian plant, the shape of leaf is also slightly different in being acute at both ends. but were one to pay too much attention to leaf-forms one would have to describe nearly every *Metrosideros* tree in the Hawaiian Islands.

Heller's No. 2762 labeled *Nania macropus* is the closest specimen to var. γ *vitiensis*, the flowers are exactly of the same size and the pedicels 1 mm. in length, only the leaves are on slightly longer petioles. It has nothing in common with *Metrosideros macropus*, and must be referred to *Metrosideros collina* forma *sericea*. Here also belongs Heller's No. 2690, with subcordate leaves, and No. 3417, both from Kauai, between the Hanapepe and Wahiawa rivers.

REMARKS

In the Herbarium Hortus Botanicus Bogoriensis (Botanic Gardens, Buitenzorg, Java) are the following sheets of *Metrosideros*:

1. *Metrosideros collina* (F.) Gray, var. γ *vitiensis* Gray, collected by J. Horne, 1877-1878, in Fiji Islands, No. 863, and was originally labeled *Metrosideros polymorpha*.

2. *Metrosideros villosa* Smith (originally labeled *M. polymorpha*), referable to *Metrosideros collina*, collected by Fullagar on Lord Howe's Island. The flowers are pedicellate and silky canescent, the capsule is large oblong; the leaves glabrous, thick and leathery, veins prominent on both sides.

3. Another specimen collected by Reinecke in Tutuila: Lepiva, Samoa, in December, 1894, No. 643; referable to *Metrosideros collina*, is a small leaved form of the type of the Hawaiian small leaved var. *glaberrima*; the fruits (immature?) are very small.

Besides the specimens referable to *M. collina* (F.) Gray the following are also represented:

1. *Metrosideros ternifolia* F. v. M. Queensland, ex Museum of Melbourne; the leaves are needle-like, flowers small.

2. *Metrosideros porphyrea* Schlechter from New Caledonia, collected by Mme. Le. Rat, 9 October, 1909, No. 33. Leaves small, corymbs short, flowers very small and subglabrous.

3. *Metrosideros ramiflora* Lauterbach from New Guinea, collected by Von Ritmers, November 6, 1909, No. 838. Det. as new species by C. Lauterbach. (The plants are from Netherlandish, New Guinea.)

4. *Metrosideros operculata* Lab. from New Caledonia, collected by M. Pancher in 1870.

5. *Metrosideros Engleriana* Schlechter, a shrub 6-10 feet in height, growing on the slopes of Mt. Ngoye, 2400-3600 feet elevation, in New Caledonia, collected November, 1902, by R. Schlechter.

6. *Metrosideros leptopetala* F. v. Mueller, collected in November, 1896, at Port Jackson, N. S. Wales, Australia.

7. *Metrosideros nervulosa* C. Moore et F. v. Mueller, from Lord Howe's Island.

The manuscript of this paper was already in the printer's hands when the writer received a package containing specimens of species of *Metrosideros* deposited in the United States National Herbarium, through the courtesy of the authorities of the Smithsonian Institute, to whom the writer wishes to express his sincere thanks. The specimens represent mostly plants collected in Hawaii and in the South Sea Islands, by the U. S. Exploring Expedition and later collectors. Some of them are duplicates of those in the Gray Herbarium.

The following here enumerated are of immediate interest:

No. 49423=*Metrosideros collina* var. *glaberrima* from Tahiti; Coll. U. S. Expl. Exped.

- Nos. 340568=Referable to *Metrosideros collina* var. γ *vitiensis* Gray. Collected 341969 by Dr. Reinecke, No. 643, in Tutuila;—Lepiva, Samoa, in December, 1894.
- No. 239500=*Metrosideros collina* var. *glaberrima* collected by M. Bidwill in the Society Islands; ex Herbarium Hookerianum (1867). (Without name.)
- No. 652926=*Metrosideros collina* var. *villosa* A. Gray. Coll. by J. E. Tilden in Papeari, Tahiti, Society Islands, Oct., 1909. The plant is labeled: 61. *Metrosideros villosa* Sm.
- No. 49422=Identical with No. 652926; Coll. U. S. Expl. Exped. in Tahiti.
- No. 49424=*Metrosideros collina polymorpha* var. *glaberrima*. Coll. U. S. Expl. Exped. on Oahu, labeled *Metrosideros polymorpha* ζ Gray.
- No. 49426=*Metrosideros collina polymorpha glaberrima* f. *sericea* Rock, Coll. U. S. Explor. Exped., labeled *Metrosideros polymorpha* var. ϵ .
- No. 265134=*Metrosideros collina polymorpha* var. *glaberrima*, Coll. A. A. Heller, No. 2484, Hanapepe River, Kauai, July 2-8, 1895.
- No. 49427=Two specimens on one sheet, representing two different varieties of *Metrosideros collina polymorpha*; the right-hand one is the writer's var. *Newellii*, the left one is doubtfully referred to var. *glaberrima*. Coll. U. S. Expl. Exped. Sandwich Islands; labeled *Metrosideros polymorpha* var. δ .
- No. 49428=One sheet with two different specimens of *Metrosideros*; the left-hand one is the writer's var. *Haleckalensis*, while the right-hand one is var. *a typica* with heartshaped tomentose leaves (marked var. γ Gray). Coll. U. S. Expl. Exped. Sandwich Islands.
- No. 49429=Leaf specimen only is var. *incana*, marked *Metrosideros polymorpha* near var. β from Puna, Hawaii. Coll. U. S. Explor. Exped.
- No. 265488=*Metrosideros tremuloides* (Heller) P. Knuth. Heller's No. 2895, *Nania tremuloides*, Oahu, Nuuanu Pali, Oct. 29, 1895.
- No. 265505=*Metrosideros collina polymorpha* var. *a typica*. Heller's spec. of *Nania polymorpha* (Gaud.), May 28, 1895, slopes of Konahuanui above Manoa.
- No. 262854=*Metrosideros collina polymorpha* var. *glaberrima* f. *sericea*=Heller No. 2053, *Metrosideros polymorpha*. Oahu, along Tantalus, April 2, 1895.
- No. 264091=*Metrosideros collina polymorpha* var. *glaberrima*=Heller's No. 2219. Konahuanui, above Manoa, April 25, 1895.
- No. 265169=*Metrosideros collina polymorpha glaberrima* f. *sericea*=Heller's No. 2417 *Nania*. July 18, 1895, between the Hanapepe and Wahiawa rivers.
- No. 239501=*Metrosideros collina polymorpha* var. *a typica*. Ex Herb. Hookerianum (1867). Coll. by Macrae on Owhyhee.
- No. 262528=*Metrosideros collina polymorpha glaberrima* f. *sericea* Rock=Heller's 2690. Aug. 24, 1895, Hanapepe and Wahiawa rivers. *Nania* —.

- No. 262813=*Metrosideros collina polymorpha glaberrima* f. *sericea*=Heller's 2762. Aug. 24, 1895. Labeled *Nania macropus*.
- No. 49431=*Metrosideros collina polymorpha a typica*. Coll. U. S. Expl. Exped. Marked *Metrosideros polymorpha* var. β Gray, Hawaii.
- No. 49432=*Metrosideros collina polymorpha a typica*, marked "form of *M. polymorpha a*" Hawaii. (This is the Oahu form of *a typica*.—Writer.) Ex Herb. U. S. Explor. Exped.
- No. 49433=*Metrosideros collina polymorpha* var. *glaberrima*=Mann & Brigham No. 96, Oahu.
- No. 49421=*Metrosideros macropus* H. et A. Ex Herb. U. S. Expl. Exped. Sandwich Islands.
- No. 49434=*Metrosideros collina polymorpha* var. *imbricata*, labeled *Metrosideros polymorpha* var. *a*; ex Herb. U. S. Expl. Exped., Oahu.
- No. 712986=*Metrosideros collina polymorpha* var. *glaberrima* ex Herb. Bureau of Science, Manila. Coll. H. M. Curran, April, 1911. *Nania, metrosideros polymorpha*.
- No. 49430=This sheet contains two different specimens; the lower one is rather peculiar and is marked *Metrosideros polymorpha* var. verging to β . Coll. Kauai, U. S. Expl. Exped. It certainly comes close to var. *a typica* but the leaves are very large, somewhat subcordate or rather truncate, they are glabrous on both sides save for a grayish pruinose pubescence on the thickened petiole which merges into thickened and broad midrib; the capsule is large, grayish tomentose and immersed in the calyx. It cannot be placed satisfactorily, but it comes closest to var. *a typica* and may be known as forma *crassinervis*. No. 49425 seems to belong here too, having the pubescent petiole in common with No. 49430. Both may be referable to var. *glabrifolia* (Hell.) Rock. No. 49425 is labeled *Metrosideros polymorpha* var. *inter β et ϵ* . Sandwich Islands.

Among the collections made by A. L. Hitchcock during the summer months of 1916, are the following numbers of *Metrosideros*: 13794 and 13773=*M. tremuloides*; 14839=*M. coll. polym. var. prostrata* from West Maui; 15051=*M. coll. polym. var. glaberrima* forma *sericea* from Pukoo, Molokai; 14404=*M. coll. polym. var. macrophylla* from Waimea, Hawaii. Of special interest is No. 15176 which is *M. coll. polym. var. prostrata* f. *strigosa* from the swamps of Molokai. Nos. 14980 from Haleakala Crater and 15587 from Mt. Hualalai, Hawaii, belong to *M. coll. polym. var. a typica*, as well as 14633 from Mauna Loa, Hawaii.

