

STUDIES OF TROPICAL AMERICAN FERNS—NO. 5.

By WILLIAM R. MAXON.

INTRODUCTION.

The following paper, like earlier ones published¹ under the same collective title, relates mainly to lesser groups of tropical American ferns which have been either neglected or very generally misunderstood. Examples of the latter sort are found in *Hemitelia* (section *Euhemitelia*) and the group of *Polypodium duale*; and of the former in the American representatives of the genus *Oleandra*. The last mentioned fall under several readily recognized species, marked by excellent characters, and their classification was made comparatively easy by the presence of sufficient material and a definite knowledge of the few species previously described. The study of *Euhemitelia* and of the *Polypodium duale* group, however, offered the usual difficulties connected with an examination of scattered type specimens.

The case of *Polypodium myosuroides*, a species of the last group, affords indeed an excellent illustration of the value of type specimens, since it involves the mistaken application of this name for exactly 100 years. As explained below, the name *Polypodium myosuroides* was given by Swartz in 1788 to certain Jamaican specimens of which it is peculiarly descriptive. In 1804 Schkuhr figured mistakenly, as an example of *myosuroides*, a second Jamaican species. Later authors, including Willdenow and Swartz himself, accepted Schkuhr's plate as illustrating *P. myosuroides*, although it represents a very distinct species latterly distinguished by Jenman (under the wrong name) and renamed *P. delitescens* by the writer in 1905. The confusion of the two by Swartz and Willdenow is partially explained by the preservation of a small detached frond of *P. delitescens* among the tufts of *P. myosuroides* in the Swartz herbarium at present and by the fact that both species are represented in the fragments sent by Swartz to Willdenow.

In the writer's opinion fern study is not seriously hampered by that lack of appreciation of the value of types which is evident among workers in some other groups. The confusion in the case just cited arose partly from a paucity of material, and a consequent failure

¹ Contr. U. S. Nat. Herb. 10: 473-508. pls. 55, 56. March 30, 1908. Ibid. 13: 1-43. pls. 1-9. June 30, 1909. Ibid. 16: 25-62. pls. 18-34. June 19, 1912. Ibid. 17: 133-177. pls. 1-10. June 20, 1913.

to recognize in it two distinct species, and partly from the fact that the fragmentary specimens sent out by Swartz happened to include fronds which were not really of the species represented by the bulk of his original material. To a certain extent, then, Swartz's original specimens are a mixture, and the case on this account is somewhat unusual. But if it shows that, in rare instances, supposed portions of "original" specimens of species so small as this are not necessarily authentic, it points out at the same time the greater necessity that often exists for studying at first hand the actual type of a species. That blind adherence should be given to characters offered by a figure or by a fragment of a purported "type," if it be opposed to a satisfactory original diagnosis bringing out a very different set of characters, is scarcely to be thought of; nor on the other hand a similar adherence to a diagnosis that is obviously faulty, if there be available an illustration that is dependable. As a matter of fact it happens not infrequently that an examination of the actual type will harmonize errors of both the artist and the describer of a species.

On every account, therefore, it is of the highest possible necessity that actual type specimens shall not only be carefully preserved but very plainly indicated as such. Considering the far-reaching importance of the subject it is, furthermore, rather astonishing that in certain quarters the "type idea" should be so utterly ignored or even deprecated and in others so little understood as to be of no especial value to either an author or his readers.

THE AMERICAN SPECIES OF OLEANDRA.

In Christensen's Index Filicum only two species of *Oleandra* are recognized from North and South America. One of these, *Oleandra nodosa*, is a common species which, as explained hereafter, must bear the older name *O. articulata*. The other species, *O. neriiformis*, was described originally from the Philippines; and the American plants associated hitherto under this name are not only distinct from the Philippine, as might be expected, but represent not less than eight readily recognizable species. Of these, two, *O. pilosa* Hook. and *O. trujillensis* Karst., from the Guianas and Venezuela, were published long ago, and six, from Central America, Panama, and Colombia, must now be described as new. There are in addition two valid species allied to *O. articulata*: *O. hirta* Brack., from Brazil and the recently described *O. bradei*, from Costa Rica, making eleven in all from North and South America.¹

These fall readily into two groups, as indicated in the key: The first, typified by *O. articulata* (*O. nodosa*), having the rhizomes

¹ An additional species, *O. micans* Kunze, from Peru, can not be determined from the short and wholly inadequate description. It is referred by Christensen to *O. nodosa*—that is, to *O. articulata* of this paper; but it is probably of the other group.

slender and more or less densely covered with spreading, linear-subulate scales; the other, comprising the *neriiformis* allies, having the rhizomes much stouter and completely obscured by appressed, densely imbricate, oblong-lanceolate to lance-acuminate scales. The two types are very distinct and the segregation of the species composing each group is not difficult. That only one species (*O. bradei*) should have been described from America during the last 50 years is remarkable, but perhaps attributable to lack of material. Even Kunze, in publishing a brief revision of the genus in 1851,¹ recognized only three American species: *O. nodosa*, *O. pilosa*, and *O. micans*, previously mentioned. Of Old World species he enumerated twelve (besides three doubtful ones), most of which have since been reduced to *O. neriformis*, though it is probable that they are well founded. Future collections will increase rather than decrease the number of American species here recognized.

The specimens here cited are all in the U. S. National Herbarium.

KEY TO THE SPECIES.

Rhizomes creeping, slender, squarrose-paleaceous.

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|---|---------------------------|
| Lamina hairy, long-decurrent | 1. <i>O. hirta</i> . |
| Lamina glabrous, cuneate at the base. | |
| Rhizomes pruinose, laxly and deciduously paleaceous. | 2. <i>O. bradei</i> . |
| Rhizomes brownish, densely and persistently paleaceous..... | 3. <i>O. articulata</i> . |

Rhizomes ascending or climbing, densely appressed-paleaceous.

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|--|------------------------------|
| Phyllopodia 6 to 25 mm. long, slender, like the stipe. | |
| Veins 14 to 18 per centimeter; scales of costæ orbicular-cordate to cordate, acute or acutish..... | 4. <i>O. guatemalensis</i> . |
| Veins 20 to 28 per centimeter; scales of costæ smaller and darker, cordate-ovate or deltoid-ovate, acuminate | 5. <i>O. lehmannii</i> . |

Phyllopodia 1 to 3 (rarely 5) mm. long, usually thick, oblique and at first densely paleaceous like the rhizomes.

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| Stipes wanting or nearly so, the lamina long-attenuate downward..... | 6. <i>O. decurrens</i> . |
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 Stipes 5 to 30 mm. long, the lamina sometimes narrowly cuneate, but always distinctly stipitate.

 Indusia ciliate.

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|--|---------------------------|
| Veins 23 to 30 per centimeter; cilia of indusia long and persistent..... | 7. <i>O. pilosa</i> . |
| Veins 16 or 17 per centimeter; cilia short and apparently few or caducous..... | 8. <i>O. panamensis</i> . |

 Indusia not ciliate.

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| Costæ barbate-squamose and long-hirsute..... | 9. <i>O. trujillensis</i> . |
| Costæ neither barbate-squamose nor long-hirsute. | |

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| Scales of costæ mostly lanceolate and glandular-fimbriate..... | 10. <i>O. trinitensis</i> . |
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| Scales of costæ deltoid, nearly all deeply lacerate-filamentose..... | 11. <i>O. costaricensis</i> . |
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¹ Bot. Zeit. 9: 345-349. 1851.

1. *Oleandra hirta* Brack. in Wilkes, U. S. Expl. Exped. 16: 214. 1854.

TYPE LOCALITY: Organ Mountains, Brazil.

DISTRIBUTION: Brazil.

ILLUSTRATION: Op. cit. pl. 29.

Only the type specimen in the U. S. National Herbarium has been examined. This is well portrayed in the published plate. From its two near American relatives with spreading linear rhizome scales *O. hirta* may at once be distinguished by its hirsute surfaces and narrower, decurrent laminae.

2. *Oleandra bradei* Christ, Bull. Soc. Bot. Genève II. 1: 231. 1909.TYPE LOCALITY: La Palma, Costa Rica, altitude 1,300 meters (*C. Brade*).

DISTRIBUTION: Known only from Costa Rica.

Oleandra bradei is very much smaller than the next species and is well marked by its whitish rhizomes and fewer, more laxly spreading scales.

SPECIMENS EXAMINED:

COSTA RICA: Vicinity of La Palma, alt. 1,450 to 1,550 meters, on tree trunk at edge of forest, *Mazon* 389, 404.

3. *Oleandra articulata* (Swartz) Presl, Tent. Pter. 78. 1836, as to name only.*Aspidium articulatum* Swartz, Journ. Bot. Schrad. 1800²: 30. 1801.*Polypodium articulatum* Poir. in Lam. Encycl. 5: 514. 1804, in part.*Aspidium nodosum* Willd. Sp. Pl. 5: 211. 1810.*Oleandra nodosa* Presl, Tent. Pter. 78. 1836.TYPE LOCALITY: Martinique (*Plumier*).

DISTRIBUTION: General in the West Indies; on the continent extending from Guatemala to Panama, Guiana, and Brazil (São Paulo).

ILLUSTRATION: Plum. Trait. Foug. pl. 136; Schkuhr, Krypt. Gewächse. 1: pl. 27. 1804.

The original description of *Aspidium articulatum* in Schrader's Journal reads as follows:

A. articulatum, frondibus ellipticis glaberrimis, punctis fructif. catenulatis sparsis, stipitibus articulatis e stolone repente.*

Plum. fil. t. 136.

Plumier's illustration, which represents a Martinique specimen, is thus (so far as the published record goes) the sole basis of Swartz's description of this common tropical American species. Poiret, however, in 1804 extended the limits of *A. articulatum* by including specimens from Mauritius, in which he was followed also by Swartz.¹ Willdenow, in 1810, perceiving the species to have become an aggregate, divided it into two; but unfortunately he retained the name *articulatum* for the Mauritius element and gave the new name *nodosum* to the Martinique plant of Plumier, which really should have been and must now be regarded as the type of *articulatum*.

There being, however, the possibility that Swartz had drawn his original diagnosis at least in part from a Mauritius plant (notwithstanding his citation of the Plumier figure), the writer asked Dr. Carl Lindman, of Stockholm, kindly to determine from the Swartzian herbarium: (1) Whether there is any indication that Swartz had a Mauritius plant at hand in 1801 and (2) whether his description was meant to include any besides the West Indian specimen of Plumier's figure. In reply both Doctor Lindman and his assistant, Dr. Erik L. Ekman, have expressed their entire agreement with the writer that the species was founded wholly upon Plumier's plate 136. Doctor Ekman states that "Swartz most probably had no West Indian specimen of *Asp. articulatum* at hand when he made his description, as there is none in his herbarium. However, he has, at a later occasion, identified with his *Asp. articulatum* of 1801 an Old World *Oleandra*, having short stipes, narrower lamina, somewhat broader squamæ, etc.,² this specimen being marked *Aspidium articulatum*, perhaps by Swartz's hand.

¹ Syn. Fil. 42, 236. 1806.

Doctor Ekman adds: "Swartz surely had not this Old World plant in his mind when he made the description of *Asp. articulatum*. It agrees not with the words 'frondibus ellipticis,' nor could he say 'stipitibus articulatis e stolone repente' according to this specimen, because there are no subterranean parts at all on it, the specimen consisting only of two laminae with their short stipes. I am absolutely convinced that Swartz had the Plumier figure before him when he made his description; and this illustration, thus, is the type of *Asp. articulatum* Swartz, 1801."

Under the circumstances it is manifestly proper to restore the name *articulatum* to the West Indian plant, as originally applied, and write *nodosum* as its synonym. The Mauritius plant wrongly called *Oleandra articulata* since Willdenow's time is thus left without a name, unless it proves identical with *Oleandra welwitschii* Baker, described originally from Angola.

4. *Oleandra guatemalensis* Maxon, sp. nov.

Rhizome scandent, about 3 mm. thick, sparingly branched, densely appressed-paleaceous, the scales closely imbricate, lance-subulate from an oblong base, castaneous with lighter borders, slightly fimbriate; phyllopodia distant or subfasciculate, 8 to 25 mm. long, slender, naked or with a few scales at the base; stipes 0.5 to 4 cm. long, olivaceous, glabrous; lamina 10 to 35 cm. long, 2 to 3 cm. broad, broadly linear, slightly falcate, usually tapering in both directions from near the middle, cuneate at the base, the apex long-acuminate, conspicuously caudate; costa strongly elevated, greenish to light olivaceous, glabrous, scantily but persistently paleaceous (at least in the lower half), the scales borne at the sides, yellowish brown, nearly or quite concolorous, orbicular-cordate to cordate, acutish, glandular-denticulate; veins arising singly or in pairs, simple or once (rarely twice) forked, 14 to 18 per centimeter near the margin; sori about 1 mm. broad, usually few, forming an irregular series near the costa; indusia orbicular-reniform, perfectly entire, glabrous. Leaf tissue yellowish green, coriaceous (the margins cartilaginous and closely revolute), glabrous, or slightly glandular below.

Type in the U. S. National Herbarium, no. 473315, collected from a tree trunk in forest along the trail from Senahú to Actalá, Alta Verapaz, Guatemala, January 17, 1905, by William R. Maxon and Robert Hay (no. 3333).

ADDITIONAL SPECIMENS EXAMINED:

GUATEMALA: Trail from Esperanza to Purulhá, *Maxon & Hay* 3361. Coban, Dept. Alta Verapaz, alt. 1,300 meters, *von Türckheim* (J. D. Smith, no. 983). Forest near Coban, Alta Verapaz, alt. 1,600 meters, epiphytic, *von Türckheim* II. 2110.

Oleandra guatemalensis is nearest-related to *O. lehmannii*, from which it may be distinguished by the key characters. The fronds are actually and relatively broader and less coriaceous than in that species and the plants are of very different appearance.

5. *Oleandra lehmannii* Maxon, sp. nov.

Rhizome scandent, similar to that of *O. guatemalensis*, but the scales a little shorter, narrower, more rigid, dark castaneous, short-fibrillose; phyllopodia mostly distant, 8 to 18 mm. long, slender, naked or scaly at the base; stipes 1 to 3.5 cm. long, light brown, slender; lamina 15 to 23 cm. long, 1.2 to 2 cm. broad, linear, straight or slightly falcate, gradually narrower in the basal third, narrowly cuneate, the apex rather abruptly long-acuminate, caudate; costa prominent, deciduously scaly at the sides in the lower half, the scales cordate-ovate to deltoid-ovate, glandular-denticulate, the lower ones more elongate; veins arising in 2's or 3's, simple or mostly once forked, 20 to 28 per centimeter near the margin; sori about 1 mm. in diameter, numerous, a single complete row close to the costa, an incomplete irregular second row beyond; indusia orbicular-reniform, small, glabrous. Leaf tissue lustrous, yellowish green, very coriaceous, glabrous, the margins strongly cartilaginous and broadly revolute.

Type in the U. S. National Herbarium, no. 828705, collected in forest south of and above Amalfi, Colombia, altitude 2,000 meters, October, 1884, by F. C. Lehmann (no. XLII).

ADDITIONAL SPECIMEN EXAMINED:

COLOMBIA: Western range of mountains above the City of Cali, alt. 1,800 to 2,200 meters, *Lehmann* 5165.

Related to *O. guatemalensis*, as mentioned under that species.

6. *Oleandra decurrens* Maxon, sp. nov.

Rhizome scandent, 2 to 3 mm. thick, sparingly branched, closely and densely appressed-paleaceous, the scales lance-attenuate, bright castaneous throughout, at first laxly short-fibrillose; phyllopodia mostly subfasciculate at intervals, stout, short (1 to 1.5 mm. long), nearly or quite as broad, oblique, densely paleaceous; fronds sessile or nearly so, the stipe never more than 5 mm. long; lamina 15 to 23 cm. long, 2 to 2.8 cm. broad, linear-oblongate, acuminate-caudate, tapering gradually from the apical third to a slender long-attenuate alate base; costa prominent, relatively slender, densely but minutely glandular-pubescent, delicately paleaceous nearly throughout, the scales spreading, linear-lanceolate, long-attenuate, 1.5 to 2 mm. long, bright yellowish brown, the lower ones more or less fibrillose; veins arising mostly in 2's, simple or forked below the middle, 22 to 26 per centimeter near the margin; sori less than 1 mm. broad, mostly scattering, 2 to 6 mm. from the costa, forming a very irregular double row; indusia orbicular-reniform, small, long-ciliate and copiously pilose. Leaf tissue rigidly herbaceous, minutely pubescent (conspicuously so beneath), the margins slightly cartilaginous, persistently ciliate.

Type in the U. S. National Herbarium, no. 828702, collected at El General, Costa Rica, January, 1897, by H. Pittier (no. 10649).

A strongly marked species, unique among related species of this group in its long-decurrent, nearly or quite exstipitate fronds.

7. *Oleandra pilosa* Hook. in Hook. & Bauer, Gen. Fil. *pl.* 45. *B.* 1840.

TYPE LOCALITY: Berbice, British Guiana (*Schomburgk* 416).

DISTRIBUTION: Apparently known only from the three Guianas and Colombia.

ILLUSTRATIONS: Hook. & Bauer, loc. cit.; Karst. Fl. Columb. 1: *pl.* 73. *f.* 6, 7.

In general appearance this species somewhat resembles *O. costaricensis* and *O. trinitensis*. It is immediately distinguished from them by its long-ciliate indusia.

SPECIMENS EXAMINED:

FRENCH GUIANA: "Oyapok superior," epiphytic in the tops of trees, *Leprieur* 1. Without locality, *Leprieur* 2. Upon trunks of trees, in forest, rare, *Leprieur* 24.

COLOMBIA: Between Boca del Monte and Medina, province Cundinamarca, *Stübel* 669.

8. *Oleandra panamensis* Maxon, sp. nov.

Rhizome scandent, 2 to 4 mm. in diameter, densely appressed-paleaceous, the scales closely imbricate, lance-subulate, castaneous, at first conspicuously crinite-filamentous; phyllopodia subfasciculate in distant zones, 2 to 3 mm. long, stout, oblique, knob-like, paleaceous; stipes 1 to 1.5 cm. long, olivaceous; lamina 28 to 38 cm. long, 2.5 to 3.5 cm. broad, narrowly linear-oblongate, subfalcate, acuminate, long-caudate, tapering very gradually from above the middle downward to the narrowly cuneate (not long-attenuate) base; costa strongly elevated, stout, olivaceous, conspicuously glandular-pubescent, sparsely paleaceous nearly throughout, the scales spreading, lanceolate-attenuate from a broader base, hair-pointed, conspicuously glandular-fimbriate, or the lower ones slightly broader at the base, darker, and somewhat crinite-fibrillose; veins arising in 2's or 3's, many of them forked at or below the middle, not close, 16 or 17 per centimeter near the margin; sori about 1 mm. broad, apart, 2 to 6 mm. distant from the costa, more than half of them arranged in an irregular

single series; indusia orbicular-reniform, small, minutely puberulous, sparingly short-ciliate. Leaf tissue membrano-papyraceous, yellowish green, persistently and conspicuously glandular-pubescent below, sparsely so above, the margins slightly undulate, persistently ciliate.

Type in the U. S. National Herbarium, no. 715543, collected upon the Cerro Vaca, eastern Chiriqui, Panama, altitude 900 to 1,136 meters, in forest, December 25 to 28, 1911, by H. Pittier (no. 5322).

Several specimens collected at the same locality show no variation except in size. This species is perhaps closest allied to *O. costaricensis*, from which it differs particularly in its larger and persistently short-pubescent fronds and in the slender, mostly non-crinite scales of the costa, as well as in its sparingly ciliate indusia and fewer veins.

9. *Oleandra trujillensis* Karst. Fl. Columb. 1: 147. 1860.

TYPE LOCALITY: Near Escuque, Venezuela, altitude 1,000 meters, upon rocks and tree trunks.

DISTRIBUTION: Apparently known only from the original locality.

ILLUSTRATIONS: *Op. cit.* 1: *pl.* 73. *f.* 1-5.

No specimens of this species have been seen by the writer; but Karsten's very full description and elaborate illustrations leave no doubt as to its identity and distinctness. It is said to be an inhabitant of the warm zone of the mountains about Mérida, and will doubtless be found in Colombia and eastern Panama.

10. *Oleandra trinitensis* Maxon, sp. nov.

Rhizome scandent, rather freely branched, 4 to 5 mm. thick, densely appressed-paleaceous, the scales lance-subulate, 4 to 6 mm. long, fimbriate, at first sparingly fibrillose toward the tip, bright castaneous; phyllopodia numerous, distant to approximate, stout, knob-like, oblique, at first concealed by the dense covering of scales; stipes 1 to 2 cm. long, olivaceous to brown; lamina 15 to 28 cm. long, 2.5 to 4 cm. broad, linear-oblong, ligulate, straight or rarely subfalcate, acuminate to long-acuminate, broadly and often abruptly cuneate at the inequilateral base; costa strongly elevated beneath, brownish or olivaceous, nearly glabrous, persistently paleaceous at the sides, the scales spreading, reddish-brown, lanceolate and slightly glandular-fimbriate, or the lower ones deltoid-lanceolate and strongly glandular-fimbriate; veins arising in 2's or 3's, sometimes branched, 19 to 23 per centimeter near the margin; sori small, situated 2 to 6 mm. from the costa (never against it), more than half of them arranged in an irregular single series; indusia small, orbicular-reniform, not ciliate, minutely glandular-pubescent. Leaf tissue membrano-chartaceous, highly lustrous, yellowish green, somewhat iridescent, minutely puberulent, glabrescent, delicately marginate, obscurely and very scantily ciliate, the hairs caducous.

Type in the U. S. National Herbarium, no. 50836, collected in Trinidad, 1877-78, by A. Fendler (no. 114).

ADDITIONAL SPECIMENS EXAMINED:

TRINIDAD: Heights of Aripo, *Coll. Bot. Gard. Trinidad* 333 (two sheets). Also a second sheet of the type collection.

An ally of *O. costaricensis*, from which it differs obviously in the strap-like shape of its fronds and the character of the costal scales.

11. *Oleandra costaricensis* Maxon, sp. nov.

Rhizome scandent, 2.5 to 5 mm. thick, densely appressed-paleaceous, the scales lance-subulate, castaneous and conspicuously crinite-fibrillose; phyllopodia distant to subfasciculate, 1 to 5 mm. long, densely paleaceous at first, thus appearing stout; stipes 0.5 to 2 cm. long, slender, light brown, deciduously paleaceous; lamina 15 to 25 cm. long, 1.5 to 4 cm. broad, very variable in shape, linear-oblong to linear-oblong, acuminate, long-caudate, gradually narrowed in the lower part and narrowly

cuneate (sometimes abruptly so); costa strongly elevated beneath, deciduously puberulous, noticeably but deciduously paleaceous at the sides, the scales reddish brown, deltoid, irregularly and deeply lacerate-filamentous; veins arising in 2's or 3's, 18 to 24 per centimeter near the margin; sori rather large, situated 1 to 7 mm. from the costa, mostly arranged in an irregular row; indusia subpersistent, not ciliate, nearly or quite glabrous. Leaf tissue varying from membrano-herbaceous to rigidly herbaceous, lustrous, often iridescent, minutely glandular-pubescent beneath but soon glabrescent.

Type in the U. S. National Herbarium, no. 366014, collected in forest at La Palma, Costa Rica, altitude 1,459 meters, September 8, 1898, by A. Tonduz (no. 12551).

ADDITIONAL SPECIMENS EXAMINED:

COSTA RICA: Orosí, Finca Valverde, alt. 1,400 meters, *A. Brade* 16836. La Fortuna, between Cervantes and Pacayas, alt. 1,400 meters, on tree trunks, March, 1906, *Biolley*. Helechales del General, Vallée du Diquís, alt. 700 meters, *Pittier* 12011. Without locality, *Cooper*; *Wercklé*.

The above description is drawn mainly from the type specimen and a second sheet of the same collection. The additional specimens cited are mostly incomplete and either partially sterile or poorly dried, so that their reference here is attended with some doubt. They are like the type in minute characters, however, and especially in the characters afforded by the costal scales, which distinguish this species very clearly from the others here recognized. The older fronds appear to be glabrous; but it is possible in all cases to detect traces, at least, of the minute pubescence in protected places along the costa. The iridescent coloration, when present, is very striking.

NOTES UPON POLYPODIUM DUALE AND ITS ALLIES.

The Jamaican fern first described by Swartz in 1788 under the name *Acrostichum serrulatum*, and since known generally as *Polypodium serrulatum* Mett., is one of a small group of species regarded by several writers in the past as constituting a separate genus, *Xiphopteris*, distinct from *Polypodium*. This group of species is not so recognized at present and can not be maintained as a valid genus, since there is nearly every gradation in form between its type species, "*Polypodium serrulatum*," and several small members of *Polypodium* (section *Eupolypodium*) related to *P. trichomanoides*. The name *serrulatum* not being available, however, for the type species just mentioned, the new name *duale* has been proposed by the writer in a recent paper.¹ The full synonymy of *P. duale* is given below.

The species which were associated with *P. duale* [*P. serrulatum* (Swartz) Mett.] by Hieronymus are treated in the following pages. Several of these, notably *P. myosuroides*, have been greatly misunderstood and neither Hieronymus² nor the writer³ has heretofore been wholly successful in the effort to do away with existing confusion. In the present study the writer has had the advantage of examining most of the material in the Berlin herbarium, studied by Hieronymus, in addition to the ample series from Jamaica in the United States National Herbarium. But even with these specimens at hand

¹ Contr. U. S. Nat. Herb. 16: 61. 1912. See also p. 399, below.

² *Hedwigia* 44: 80-90. 1905.

³ *Bull. Torrey Club* 32: 73-75. 1905.

there remain several collections which can not be placed definitely at the present time. There will be, however, a decided advantage in fixing upon and illustrating the typical form of *P. myosuroides*, which apparently is confined to Jamaica, and the Jamaican species figured erroneously as *myosuroides* by Schkuhr and renamed *Polypodium delitescens* by the writer several years ago. With more ample material in the future it will be possible to determine whether either occurs upon the continent.

The following key is adapted from that of Hieronymus:

KEY TO THE SPECIES.

- Rhizomes conspicuously elongate; scales of the rhizome delicate, with thin, fulvous partition walls 1. *P. duale*.
- Rhizomes ascending; scales of the rhizome with thick, dark brown partition walls.
- Fertile fronds not sharply differentiated into two difform sterile and fertile parts 3. *P. delitescens*.
- Fertile fronds sharply differentiated into a caudate fertile terminal portion and a difform inferior sterile portion.
- Margins devoid of dark bristle-like hairs 6. *P. wittigianum*.
- Margins bearing minute, scattered, dark brown, bristle-like hairs.
- Sterile segments mostly oblong 2. *P. myosuroides*.
- Sterile segments more numerous, mostly of a deltoid type, often broader than long.
- Leaf tissue thin, translucent; marginal hairs few and very minute 5. *P. saffordii*.
- Leaf tissue thick, nearly opaque; marginal hairs evident, though small and fragile 4. *P. strictissimum*.

1. *Polypodium duale* Maxon, Contr. U. S. Nat. Herb. 16: 61. 1912.

Acrostichum serrulatum Swartz, Prodr. Veg. Ind. Occ. 128. 1788.

Grammitis serrulata Swartz, Journ. Bot. Schrad. 1800²: 18. 1801.

Asplenium serrulatum Swartz, Fl. Ind. Occ. 3: 1607. 1806.

Gymnopteris serrulata Bernh. Neu. Journ. Bot. Schrad. 2²: 48. 1806.

Xiphopteris serrulata Kaulf. Enum. Fil. 85. 1824.

Micropteris serrulata Desv. Mém. Soc. Linn. Paris 6: 217. 1827.

Micropteris orientalis Desv. Mém. Soc. Linn. Paris 6: 217. 1827, not *Polypodium orientale* Gmel. 1791.

Polypodium serrulatum Mett. Fil. Hort. Lips. 30. 1856, not Swartz, 1801.

Xiphopteris extensa Fée, Mém. Foug. 11: 14. 1866, not *Polypodium extensum* Forst. 1786, Presl, 1825, nor Fée, 1869.

Xiphopteris orientalis Fourn. Compt. Rend. 81: 1140. 1875.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Common nearly throughout the American tropics; occurs also in Africa (Kamerun, Sierra Leone, Mauritius, and Madagascar).

ILLUSTRATIONS: Schkuhr, Krypt. Gewächs. pl. 7, in part (as *Grammitis serrulata*); Hook. Exot. Fl. pl. 78 (as *G. serrulata*); Presl, Tent. Pter. pl. 9. f. 2. (as *G. serrulata*); Fée, Gen. Fil. pl. 10. B (as *Xiphopteris serrulata*); Fée, Mém. Foug. 11: pl. 19. f. 3 (as *Xiphopteris extensa*).

The present species, peculiar as it is in several particulars, appears to have been little understood by the early writers on ferns and not until 1856 was it placed in

its proper genus, then by Mettenius, as *Polypodium serrulatum* (Swartz) Mett. This however, is an untenable name, having been given previously by Swartz (in 1801) to another Jamaican fern now known as *Dryopteris serrulata* (Swartz) C. Chr. The two other specific names, *orientalis* and *extensa*, given by Desvaux and Fée, respectively, are untenable under *Polypodium* and a new name has thus been found necessary.

No detailed description of the species is required, its marked specific characters having been stated repeatedly by various writers. Hieronymus¹ in particular has supplemented Mettenius's excellent diagnosis by ample descriptive notes. All of these authors, however, have failed to emphasize one peculiar feature of the venation—the upward course of the fertile veins close to the midvein before diverging obliquely toward the margin. The sori being basal and elongate are, therefore, borne against the midvein in a double and very nearly straight line, and are confluent at

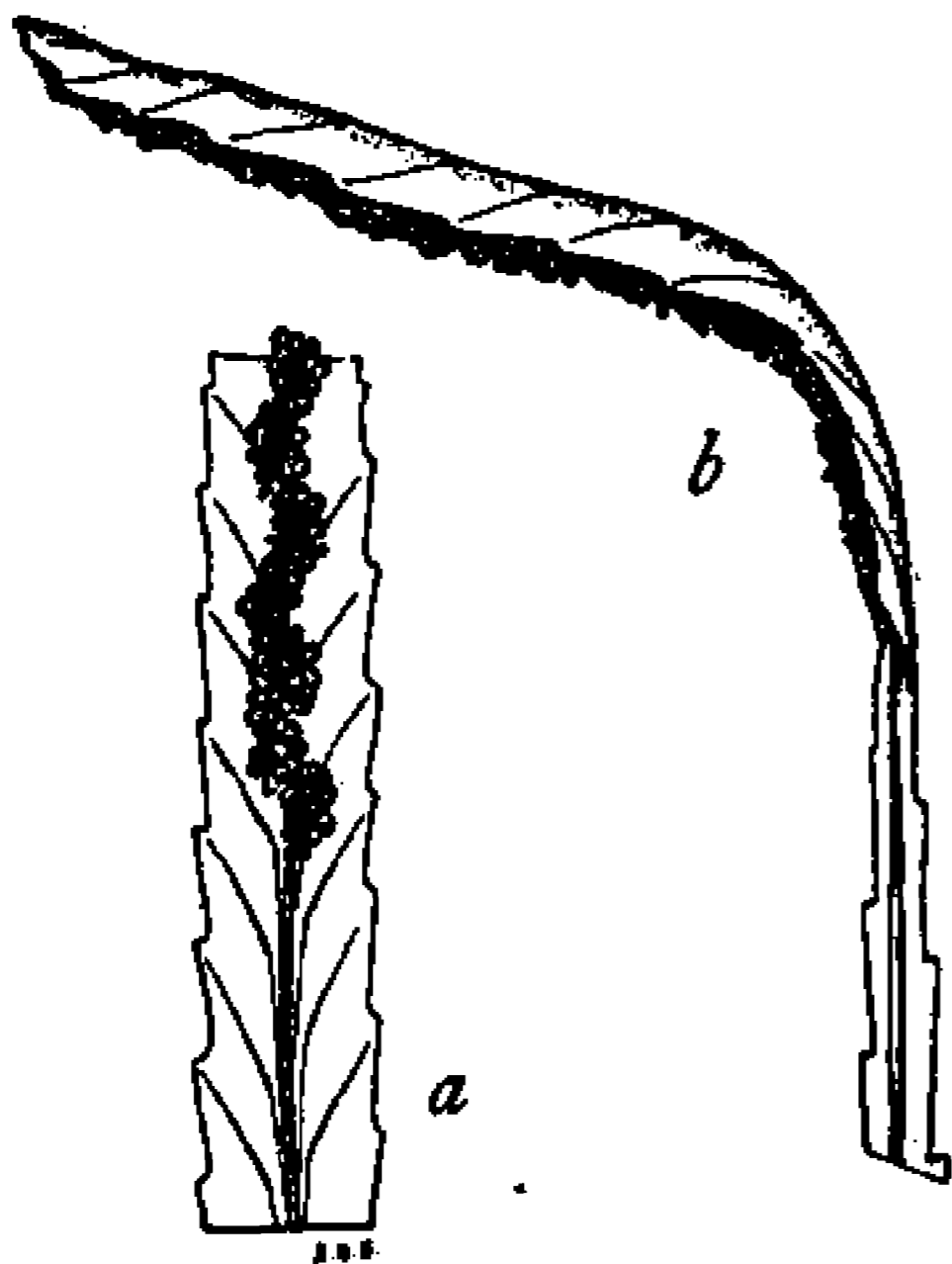


FIG. 8.—*Polypodium duale*, from Tweedside, Jamaica (Mazon 906). *a*, Lower view of fertile tip of lamina, showing the sori basal upon the veins and thus forming a sinuous line against the costa; *b*, tip of a fertile lamina, the fertile portion subplicate, a common condition at maturity. Scale 2.

all stages of growth. If the genus *Xiphopteris* of Kaulfuss is to be recognized, it must be restricted to this the type species, which differs conspicuously from most members of "Eupolypodium." But this character is only an extreme development of a tendency noted in several nearly related species and seems decidedly of less than generic importance. Hooker's plate, cited above, is excellent. The drawing by House, herewith reproduced (fig. 8), shows better, at twice natural size, the peculiar direction of the veins.

A long list of specimens is given by Hieronymus, many of these being of the older, historic collections. The following material, not cited by him, is in the U. S. National Herbarium:

JAMAICA: Second Breakfast Spring, alt. 600 meters, on wet, grassy slope, *Mazon* 906. Tweedside, alt. 600 meters, on mossy boulder, *Mazon* 980. Near Morces Gap, alt. 1,500 meters, on bank, *Mazon* 1218. Highest slopes of John Crow Peak, alt. 1,700 meters, on a mossy tree trunk, *Mazon* 1334. Vicinity

of New Haven Gap, alt. 1,650 meters, on mossy branches of forest trees, *Mazon* 2686. Cuna Cuna Pass, on rocks, *Fredholm* 3226. Morces Gap, *Harris* 7136; *Clute* 45. Northwest slopes of Dolphin Head, alt. 420 meters, *Harris* 9282. Near Cinchona, alt. 1,500 meters, on banks, *Underwood*. Without locality, *Hart* 102.

CUBA: Without definite locality, *Wright* 780.

HAYTI: Le Brande to Mount Balance, alt. 1,065 meters, on rocks, *Nash & Taylor* 1720.

PORTO RICO: Eastern slope of the Luquillo Mountains, alt. 450 meters, *Heller* 4620. Luquillo Mountains, *P. Wilson* 30, 69, 176. "Sierra de Naguabo," in arboribus vetustis sylvae montis "Piedra Belleta," *Sintenis* 1000. Mount Torresilla, *Hioram* 291.

ST. KITTS: Slopes of Mount Misery, on trees, *Britton & Cowell* 500.

GRENADA: "Morne au Camp," among mosses on trees, *Eggers* 6216. Without locality, *Sherring* 139.

ST. VINCENT: Souffrière, alt. 720 meters, among mosses on trees, *Eggers* 6709.

¹ *Hedwigia* 44: 80-83. 1905.



A. POLYPODIUM MYOSUROIDES SWARTZ.



B. POLYPODIUM MYOSUROIDES SWARTZ.

MONTSERRAT: Top of Chaners Mountains, alt. 900 meters, *Shafer* 292. Fergus Mountain, alt. 600 meters, *Shafer* 793.

GUADELOUPE: *Duss* 4099.

MARTINIQUE: *Duss* 1609.

TRINIDAD: *Fendler* 81; *Lockhart*.

MEXICO: Mirador, *Liebmann*. Zacuapan, Vera Cruz, on trees, *Purpus* 3021.

GUATEMALA: Coban, Alta Verapaz, alt. 1,350 meters, epiphytic, *von Türckheim* II. 1261. Near Finca Sepacuité, Alta Verapaz, *Cook & Griggs* 421, 535. Trail from Senahú to Actalá, Alta Verapaz, on tree trunk in forest, *Maxon & Hay* 3319, 3330.

NICARAGUA: Greytown, *Wright*.

COSTA RICA: San José, *Pittier* 1928d. La Palma, alt. 1,400 meters, *C. Brade* 71. Near Coliblanco, alt. 1,950 meters, on tree trunk, *Maxon* 282. La Palma, alt. 1,450 to 1,550 meters, *Maxon* 405.

PANAMA: Bismark, *Williams* 458.

COLOMBIA: Farallones de Cali, Cauca, alt. 2,000 meters, *Lehmann* 1982. Without locality, *Lehmann* 4933.

VENEZUELA: Juan Griego trail, Island of Margarita, alt. 450 meters, *Johnston* 144.

BRITISH GUIANA: "Our House," Mount Roraima, alt. about 1,725 meters, *in Thurn* 133.

BRAZIL: Serra do Itatiaia, *Dusen*. Minas Geraes, *Lindman* A181. Santa Catharina, *Schmalz* (Rosenstock, no. 145). Corcovado, *R. Rathbun*. Rio de Janeiro, *Mosén* 2639. Santos, *Mosén* 3731.

MAURITIUS: Without definite locality, *Mrs. Nicholas Pike*.

SIERRA LEONE: Without definite locality, *Barton*.

2. *Polypodium myosuroides* Swartz, Prodr. Veg. Ind. Occ. 131. 1788. PLATE 11. *Grammitis myosuroides* Swartz, Journ. Bot. Schrad. 1800²: 18. 1801, not Schkuhr, 1804.

Xiphopteris myosuroides Kaulf. Enum. Fil. 85, 275. 1824.

Polypodium jamesoni Jenman, Bull. Bot. Dept. Jamaica II. 4: 112. 1897, not *Xiphopteris jamesoni* Hook. 1860, nor *Polypodium jamesoni* Mett. 1883.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Higher peaks of the Blue Mountains, Jamaica, at 1,700 to 2,220 meters; of doubtful occurrence upon the continent.

Polypodium myosuroides was described originally by Swartz (in 1788) in the following words:

Frondebis pinnatifidis glabris, lobis in apicem lanceolatum coadunatis fructiferis; inferioribus remotis.

Although this description is both incomplete and inaccurate, the species name *myosuroides* is itself so peculiarly descriptive as to indicate clearly to which one of two closely allied species it was originally meant to apply. The introduction of a second species into the concept of *P. myosuroides*, and its later substitution for the species which should really bear that name, came about chiefly through Schkuhr's figuring (as *Grammitis myosuroides*) in 1804¹ a Jamaican plant, probably received from Swartz, that was not *myosuroides* but a distinct species (*Polypodium delitescens* Maxon, 1905). Whatever may have been the source of Schkuhr's specimen, Swartz evidently failed to recognize the two forms as specifically different. At any rate, in the Synopsis Filicum (1806) he cited Schkuhr's illustration without question under *myosuroides* and modified his original diagnosis materially, while in his Flora,² published in the same year, a long description is so worded as to include both forms. Both species being rare and not often collected and Swartz himself having cited Schkuhr's plate as illustrating *myosuroides*, most later writers have not unnaturally

¹ Krypt. Gewächs. 1: pl. 7. 1804.

² Fl. Ind. Occ. 3: 1644. 1806.

identified *myosuroides* with reference to Schkuhr's illustration. Thus Jenman, in his series of descriptions of the ferns of Jamaica, though properly distinguishing the two species, made the mistake of redescribing as *P. myosuroides* the species figured by Schkuhr. The true *myosuroides* of Swartz he called *Polypodium jamesoni* Jenman, since according to his view it was identical with *Xiphopteris jamesoni* Hook., a species described meanwhile from South American material, and thus did not require a new species name.

Having collected in Jamaica numerous specimens of the two species distinguished by Jenman, and having come to the conclusion that the name *myosuroides* had been applied erroneously by him, the writer published a short paper in 1905,¹ in which he restored *myosuroides* to its original application and, as previously noted, gave the name *Polypodium delitescens* to the species illustrated by Schkuhr. The main grounds for this were that the term *myosuroides*, meaning literally "mousetail-like," is not in the least appropriate to the plant figured by Schkuhr, but does exactly describe the slender, caudate, lightly sinuate-crenate fertile tips of the fronds of the other species.

While the writer's paper was in press there appeared the article by Hieronymus, in which the name *myosuroides* was used in a very doubtful sense and in which, also, the status of Schkuhr's plant was left in abeyance. The only Jamaican material of "*myosuroides*" cited by Hieronymus consists of several fragments received from Swartz which were held to be authentic. The writer thereupon sent to Dr. C. A. M. Lindman, at Stockholm, excellent specimens of what was believed to be true *myosuroides* and others representing the species figured by Schkuhr (*P. delitescens*), with the request that a comparison of these be made with Swartz's own material. Doctor Lindman replied promptly that immixed among the type tufts of *P. myosuroides* (so labeled in Swartz's own hand) he had found a single detached frond of *P. delitescens* which matched perfectly the writer's specimens of that species and the Schkuhr illustration. As substantiating this he inclosed "rubblings" of the single detached frond of *P. delitescens* and of some of the larger specimens of the type material of *P. myosuroides*. They exactly represent the two species as distinguished by the writer in 1905.

For the sake of historical clearness some further reference to Schkuhr's figure is necessary. Hieronymus points out that this was listed by Hooker under *P. setosum* (*P. micropteris* C. Chr.) and by Mettenius under *P. myosuroides*. His further comment, translated freely, is as follows:²

"Without an examination of the specimen which Schkuhr actually had in hand it would not be possible to say which of the two [i. e. Hooker or Mettenius] is right. Inasmuch as the figure shows no bristles upon the lamina and represents a plant from Jamaica (where *P. setosum* is apparently not found), one might incline to Mettenius's view and believe that it represents a young plant of *P. myosuroides* in which the fertile lamina (as exceptionally happens in this species) is not separated into two clearly differentiated parts. Still, it may be that a third (and as yet unknown) species is here represented."

Assuredly, *P. delitescens*, as shown in plate 12 and figure 10, has no near relationship with the South American *P. micropteris*. It is much nearer to *P. myosuroides* (pl. 11 and fig. 9), and the fact that Schkuhr's figure was cited under that species by Mettenius and was not definitely placed by Hieronymus may be attributed to the circumstance that the only Jamaican specimens of either *P. myosuroides* or *P. delitescens* in the Berlin herbarium are those received from Swartz. One of these (which was found mixed among specimens of *P. trichomanoides*) is fairly characteristic of *P. delitescens*. A second specimen, sent by Swartz in 1813, consists of parts of three detached fronds, two of which are *P. myosuroides*, the third being *P. delitescens*. The

¹ Bull. Torrey Club 32: 73-75. 1905.

² Op. cit. 92.

other Swartzian fragments (in the Willdenow Herbarium) have not been seen by the writer.

That Swartz's original specimens of "*P. myosuroides*" probably consisted in small part of a second species may be inferred from the presence of the single loose frond of *P. delitescens* found among the ample material of true *P. myosuroides* by Doctor Lindman, and from the mixed fragments of the two species which are preserved as authentic material of *P. myosuroides* at Berlin. It is probable also that Schkuhr's plant came from Swartz. Therefore, *Polypodium myosuroides* Swartz may be regarded technically as an aggregate. In this event the very significant species name itself must be admitted to indicate unquestionably its application to the plants having myosuroid apices (fig. 9). These apparently constituted the bulk of Swartz's material.

As to the three collections of Brazilian specimens in the Berlin herbarium, referred by Hieronymus to *P. myosuroides*: Sellow's no. 58 is apparently a small example of the form described by Hieronymus as *P. strictissimum* forma major Hieron.; Glaziou's no. 7491 is *P. schenckii* Hieron., as may be seen at once from its general form or, at least, from an examination of its peculiar rhizome scales; lastly, Glaziou's no. 7480, which is precisely the form long ago figured by Raddi,¹ represents either a new species or, more likely, a state of *P. strictissimum*. Further material of this last number is much to be desired.

The only other material cited by Hieronymus under *P. myosuroides* is Allers's no. 234, from German East Africa. This has not been seen by the writer.

The accompanying illustrations (fig. 9 and pl. 11) will serve to show the main characters of

P. myosuroides without further description. Comparative notes will be found also under *P. delitescens* and *P. strictissimum*.

The following specimens of *P. myosuroides* are in the U. S. National Herbarium:

JAMAICA: Summit of Blue Mountain Peak, alt. 2,220 meters, Maxon 1472, 1473, 1514; Underwood 1510. Below summit of Sir Johns Peak, altitude about 1,750 meters, Underwood 3180. Without locality, Hart 70. Also several specimens without exact locality, received from the Botanical Department of Jamaica.

EXPLANATION OF PLATE 11.—Specimens of *Polypodium myosuroides* from Blue Mountain Peak, Jamaica, altitude 2,220 meters. A, Maxon 1514; B, Maxon 1473. Natural size.

3. *Polypodium delitescens* Maxon, Bull. Torrey Club 32:74. 1905. PLATE 12. *Grammitis myosuroides* Schkuhr, Krypt. Gewächs. 1:9. 1804, not *Polypodium myosuroides* Swartz, 1788.

"*Polypodium myosuroides*" Jenman, Bull. Bot. Dept. Jamaica II. 4: 112. 1897, not Swartz, 1788.



FIG. 9.—*Polypodium myosuroides*, from Blue Mountain Peak, Jamaica (Maxon 1473). a, An entire plant; b, the apex and a section of the sterile portion. a, Natural size; b, scale 2.

¹ Pl. Bras. 1: pl. 22 bis. f. 2, 2a. 1825 (as *Asplenium serrulatum*).

TYPE LOCALITY: Jamaica.¹

DISTRIBUTION: Apparently confined to the high peaks of the Blue Mountains of Jamaica, altitude 1,700 to 2,220 meters.

ILLUSTRATION: Schkuhr, op. cit. pl. 7 (as *Grammitis myosuroides*).

The grounds for naming this species as above were given briefly by the writer in 1905² and have been restated, necessarily at some length, under the last preceding species. To be compared with Schkuhr's illustration are the Jamaican plants shown in plate 12 and figure 10, all of which represent *P. delitescens*. The writer's plant illustrated in figure 10 in particular is seen to agree closely with that of Schkuhr. Both represent a somewhat extreme form of *P. delitescens*, in which nearly all of the segments are distinct. Other specimens (for example, a part of those shown in pl. 12) have the upper lobes or segments somewhat confluent, the apex thus being less deeply

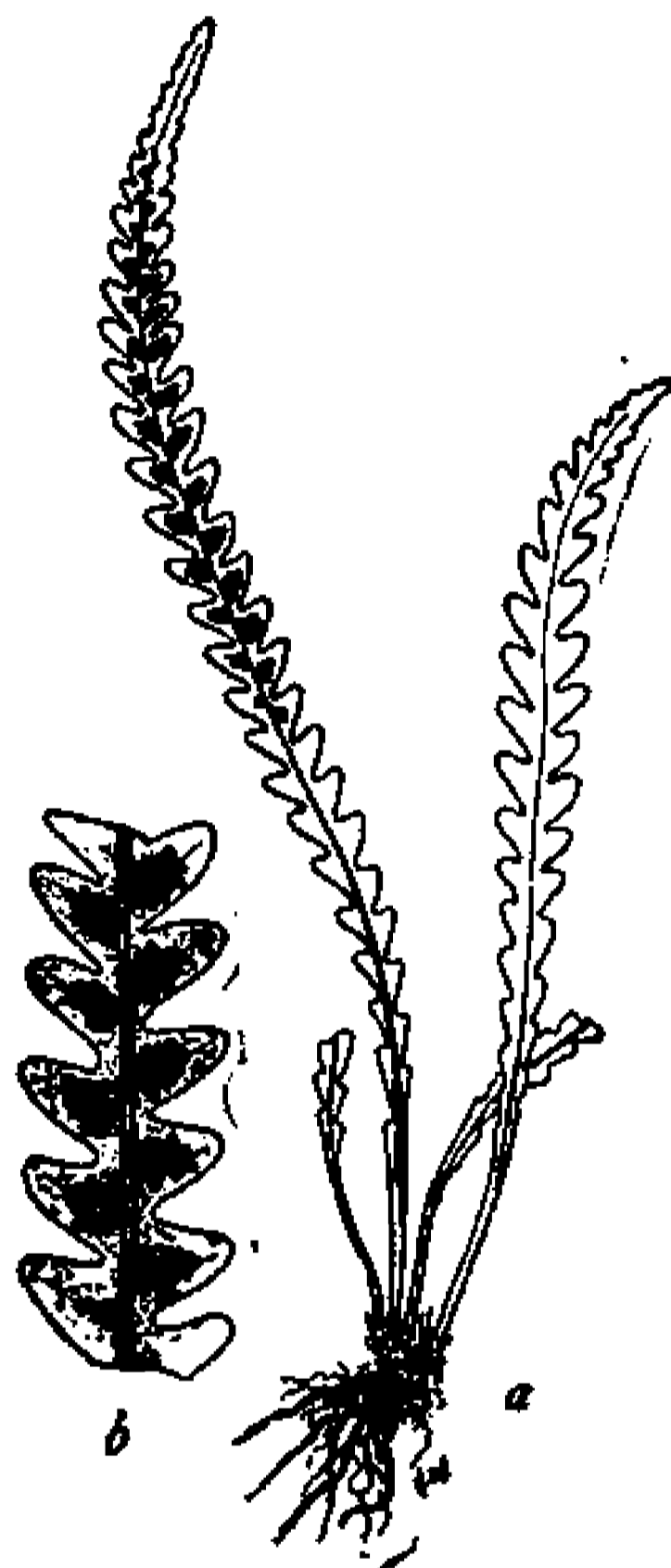


FIG. 10.—*Polypodium delitescens*, from Blue Mountain Peak, Jamaica (Maxon 1513). a, Entire plant; b, section of fertile portion. a, Natural size; b, scale 2.

incised. But it will be seen that in all of these conditions there is no sharp differentiation of a caudate fertile tip and that the sori are borne also upon the larger segments or lobes in the middle part of the blade. In other words, the apices of *P. delitescens* are usually deeply serrate or at least never assume the form characteristic of *P. myosuroides*, in which species there is invariably a sharp differentiation between the sterile and fertile portions, the latter being slender, elongate-caudate, and shallowly sinuate crenate. *Polypodium delitescens* differs otherwise from *P. myosuroides* in its approximate, nearly deltoid (instead of distant, oblong) segments and in the absence of dark bristle-like hairs upon the rachis and leaf margins. The sori, also, from their position upon separate or only partially fused lobes or segments are usually more or less distinct, never wholly losing their individuality, as Jenman has pointed out. The underside of the rachis is decidedly glandular-pubescent, instead of bristly-pubescent. The leaf tissue is much more opaque than that of *P. myosuroides*.

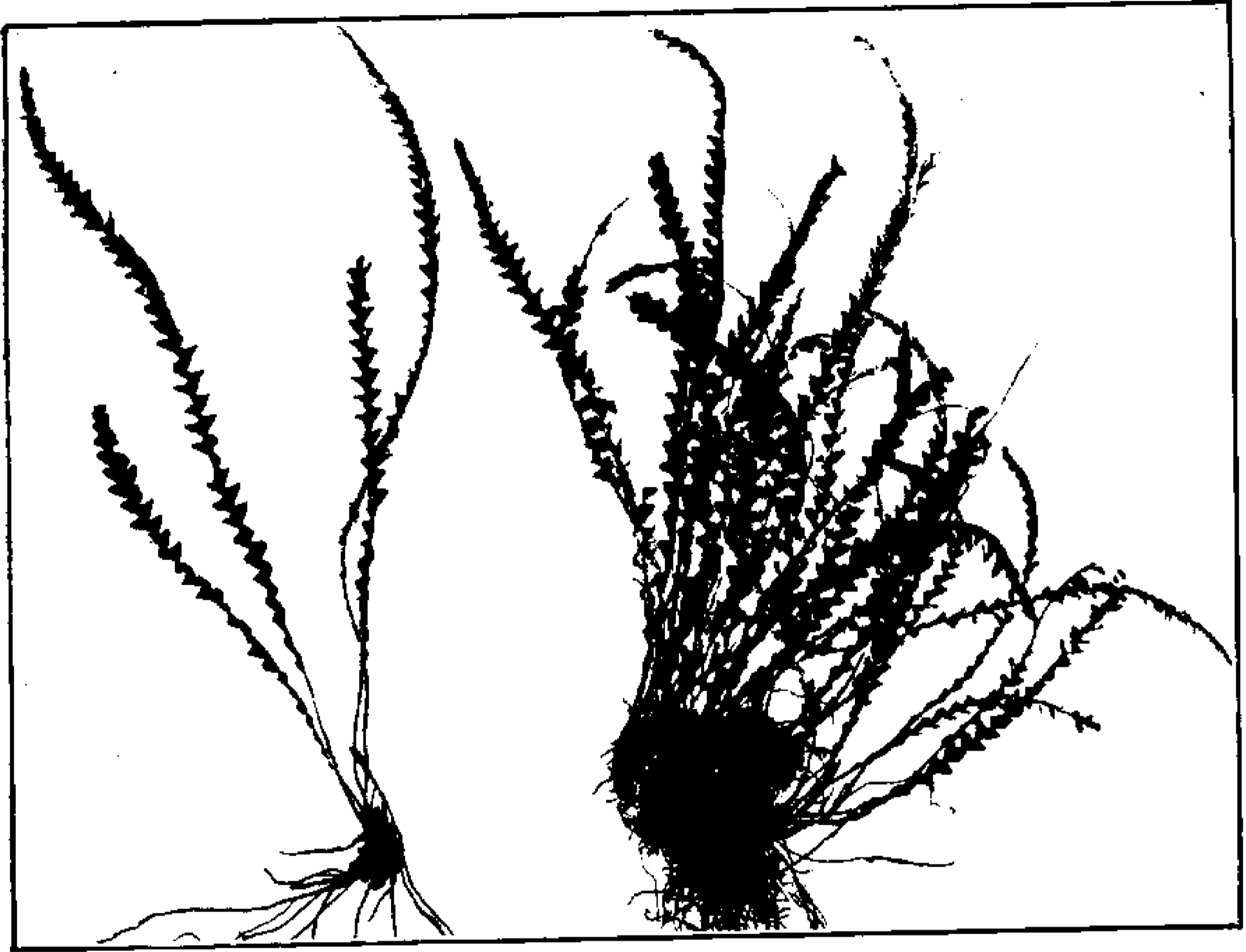
These two species are thus seen to be very dissimilar to each other, and their confusion in the past must be ascribed partly to lack of good material. That they should have been mixed in the original collection is not remarkable, since they are often found growing in close association upon the mossy branches and trunks of forest trees. Such a condition is not uncommon among many of the lower cryptogams, notably the Hepaticae, and has been observed repeatedly by the writer in the case of various small tropical American species of *Polypodium* and even of *Elaphoglossum*, where conditions have been unusually favorable to a luxuriant growth of related species requiring a similar habitat.

As noted above, *P. delitescens* is apparently confined to Jamaica. The following specimens are in the U. S. National Herbarium:

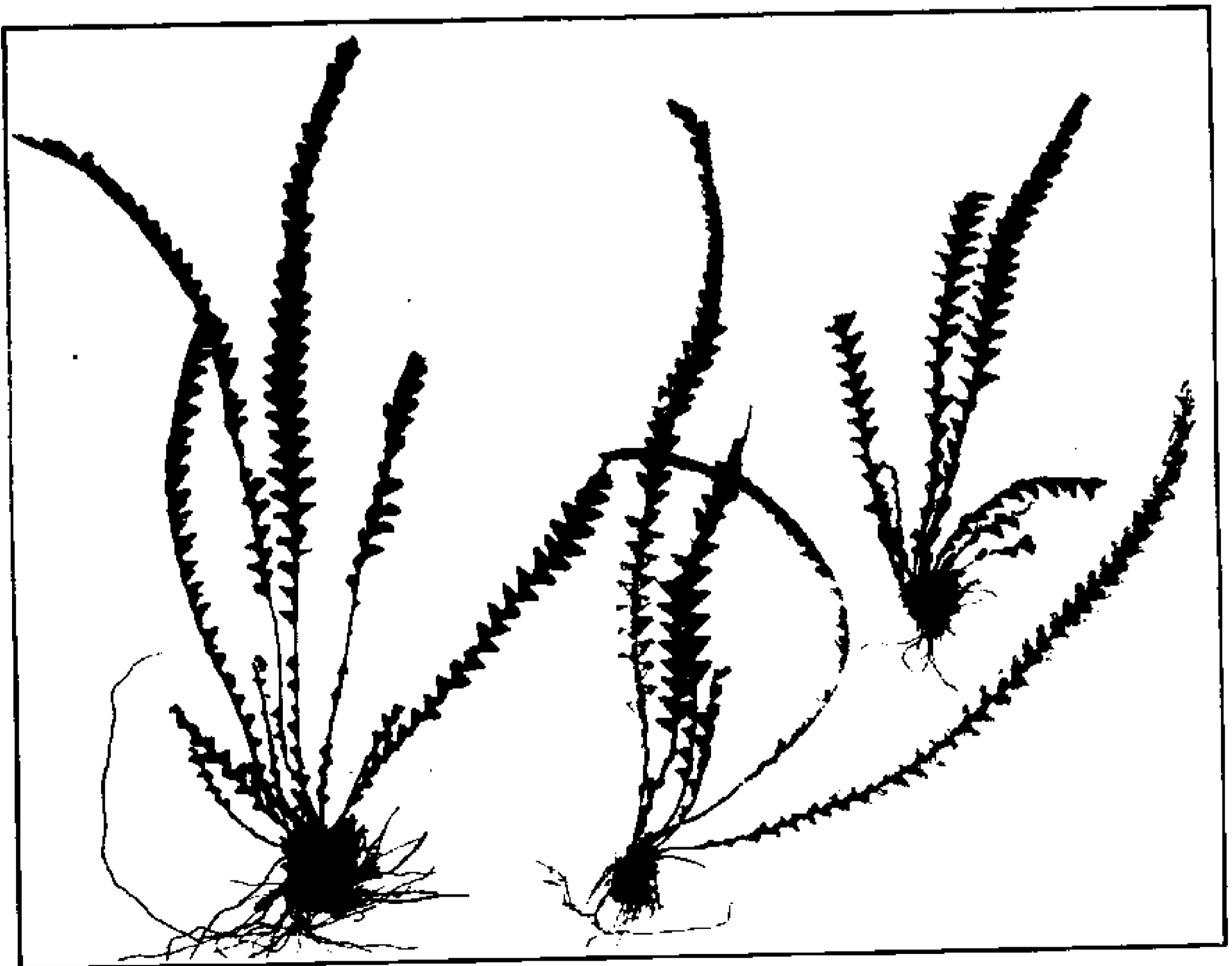
JAMAICA: Monkey Hill (above New Haven Gap), alt. 1,800 meters, Maxon 2732, 2750. Near New Haven Gap, alt. 1,700 meters, Underwood 962, 1019. Near

¹ The actual type will be Schkuhr's original plant, if extant; otherwise it will be Maxon 1513, U. S. National Herbarium 427770, as previously designated.

² Bull. Torrey Club. 32: 73-75. 1905.



A. *POLYPODIUM DELITESCENS* MAXON.



B. *POLYPODIUM DELITESCENS* MAXON.

Morces Gap, alt. 1,500 meters, *Underwood* 516. Summit of Blue Mountain Peak, alt. 2,220 meters, *Maxon* 1513. Without definite locality, *Hart* 73, 70 in small part.

EXPLANATION OF PLATE 12.—Plants of *Polypodium delitescens*, from the Blue Mountains of Jamaica. A *Maxon* 1513; B, *Maxon* 2732. Natural size.

4. *Polypodium strictissimum* (Hook.) Hieron. Bot. Jahrb. Engler 34: 501. 1904. *Xiphopteris jamesoni* Hook. Second Cent. Ferns pl. 14. 1860, not *Polypodium jamesoni* Mett., 1883, nor Jenman, 1897.

Polypodium serrulatum β *strictissimum* Hook. Sp. Fil. 4: 175. 1862.

TYPE LOCALITY: Andes of Quito, Ecuador (*Jameson*).

DISTRIBUTION: High mountains of Ecuador, Colombia, Venezuela, British Guiana, and Brazil, ascending to 3,000 meters.

ILLUSTRATIONS: Hook. Second Cent. Ferns pl. 14 (as *Xiphopteris jamesoni*); Hook. Gard. Ferns pl. 44 (as *Xiphopteris serrulata*).

The above names relate to South American plants, of which the writer had seen almost no examples in 1905 and which he then supposed to be referable to the Jamaican species, *P. myosuroides*. An examination of the specimens studied by Hieronymus, however, indicates that this material represents one or more species distinct from *P. myosuroides*.

Three forms of *P. strictissimum* are recognized by Hieronymus: forma *major*, forma *intermedia*, and forma *minor*. These differ widely among themselves, not only in size, but in shape of their lobes or segments. The type of Hooker's species, *Xiphopteris jamesoni*, and therefore of *Polypodium strictissimum* (Hook.) Hieron.¹, is the Quitensian Andes plant of Jameson, illustrated in Hooker's plate 14, above cited. This would probably come under the forma *minor* of Hieronymus. Between this and the opposite extreme described as forma *major* there are several curious and more or less intermediate conditions, of which Hooker's plate 44 represents one. Whether or not these are all conspecific, they nevertheless represent a series of forms specifically distinct from *P. myosuroides*, differing from that species constantly in their more numerous, mostly triangular segments and in their rigidly upright fronds. It is not unlikely that further collections may make possible a segregation of these as several distinct species; but it must be remembered that differences in habitat, elevation, exposure, and particularly moisture conditions may induce these differences in form, as we know to be true in the case of *P. duale*. Without further material the writer prefers at present to view *P. strictissimum* in the sense of Hieronymus.

Besides the Berlin material only two specimens (both in the U. S. National Herbarium) have been studied, these being referable to the forma *minor*.

COLOMBIA: Cuesta de Tocotá, western Cordillera, Cauca, alt. 1,500 to 1,900 meters, *Pittier* 768.

BRITISH GUIANA: Old Path, upper slopes of Mount Roraima, *in Thurn* 351.

5. *Polypodium saffordii* Maxon, Amer. Fern Journ. 2: 19. 1912.

Polypodium minimum Brack. in Wilkes U. S. Expl. Exped. 16: 5. 1854, not Aubl. 1775.

TYPE LOCALITY: Mountains behind Honolulu, Island of Oahu, Hawaiian Islands.

DISTRIBUTION: KNOWN only from the Hawaiian Islands, ascending to at least 1,200 meters.

ILLUSTRATIONS: Brack. op. cit. pl. 1. f. 3; Maxon, loc. cit. (text figs.).

This species, recently renamed and figured by the writer, was redescribed by Hieronymus under the name *P. minimum* Brack. It is readily distinguished from its

¹The earlier name *Polypodium jamesoni* (Fée) Mett., 1883, precludes the transfer of *Xiphopteris jamesoni* Hook. to *Polypodium*. Hieronymus has thus properly elevated to specific rank Hooker's varietal name *strictissimum*, which, as published, is an exact synonym of *Xiphopteris jamesoni*.

relatives by the characters given in the key herewith. The figures published by the writer do not show any of the minute, bristle-like hairs which occur sparingly near the apices of the triangular lobes of the blade. Besides being few and very minute these are caducous.

6. *Polypodium wittigianum* (Fée & Glaz.) Christ, Bull. Herb. Boiss. II. 2: 368. 1902, as to name.

Grammitis wittigiana Fée & Glaz.; Fée, Crypt. Vasc. Brés. 2: 50. 1872-73.

Grammitis muscosa Fée, Crypt. Vasc. Brés. 2: 51. 1872-73.

TYPE LOCALITY: Itatiaia, Brazil, alt. 2,300 meters (Glaziou 5300).

DISTRIBUTION: KNOWN only from Brazil.

ILLUSTRATIONS: Fée, op. cit. pl. 95. f. 1 (as *G. wittigiana*); op. cit. pl. 95. f. 2 (as *G. muscosa*).

Hieronimus's contention¹ that *Grammitis muscosa* represents a depauperate condition of the species described as *G. wittigiana* appears, from an examination of the type specimens of both, to be correct. *Polypodium wittigianum* as understood by Christ in 1902 included Schwacke's no. 839 from Brazil; but this, as represented in the Berlin herbarium, is *P. schenckii*. Ule's no. 4519, also cited by him, has not been seen.

There is a single additional collection in the U. S. National Herbarium, representing the smaller form of the species (described as *G. muscosa*).

BRAZIL: Pico Redondo, Retiro, Itatiaia, alt. 2,450 meters, June 29, 1902, Dusén 773.

EXCLUDED SPECIES.

POLYPODIUM SCHENCKII Hieron. Hedwigia 44: 87. 1905.

TYPE LOCALITY: Serra do Mar, near Joinville, province of Santa Catharina, Brazil (Schenck 1243).

DISTRIBUTION: KNOWN only from Brazil.

Polypodium schenckii, though placed by Hieronimus with "*P. serrulatum*" and its allies, must be excluded from this group on account of its forked veins and ciliate rhizome scales. Besides the three collections cited by Hieronimus, the writer has examined specimens collected near the type locality by Schmalz (distributed by Rosenstock under no. 139) and Glaziou's no. 7491. The latter, as stated on page 403, was referred to *P. myosuroides* by Hieronimus.

NEW SPECIES OF POLYPODIUM.

In the course of studying certain American species of *Polypodium* the following have been distinguished as new. The first five are members of the group of *P. trichomanoides*, taken in a broad sense, of which the writer purposes to publish a synoptical review shortly.

Polypodium hyalinum Maxon, sp. nov.

Rhizome ascending, slender, about 1 cm. long, 1.5 mm. in diameter, freely radice below, the apex crowned with a conspicuous tuft of fulvous scales, these linear-lanceolate from a slightly broader cordate base, 2.5 to 4 mm. long, 0.5 to 0.7 mm. broad near the base (here 9 to 13 cells broad, the cells relatively large, irregularly oblong, with slightly thickened fulvous partition walls), sometimes bearing a few small, irregular, simple or forked, gland-tipped processes near the base, the apical half of the scale invariably provided with straight or slightly curved, divergent unicellular hyaline acicular cilia. Fronds 4 to 7, suberect, fasciculate, 8 to 13 cm. long; stipe subterete, brownish stramineous from a darker base, 5 to 10 mm. long, thickly beset

¹ Op. cit. 89.

with spreading reddish hairs 1.5 to 2 mm. long; lamina linear, 7 to 12 cm. long, 7 to 9 mm. broad in the middle, obliquely pinnatifid nearly to the rachis, gradually narrowed at the short-caudate pinnately lobed apex, more abruptly narrowed at the base, the lower segments distant, decurrent, finally evident only as a minute wing upon the rachis, the whole lamina long-setose, conspicuously so near the apex of the segments and upon the upper side of the rachis (the hairs like those of the stipe); segments monosorous, oblique, 25 to 40 pairs, close, narrowly deltoid-oblong, slightly decurrent, obtusish, entire (except at the minutely crenulate apex), yellowish green, chartaceous; veins of the sterile segments simple, the strongly clavate apex easily seen upon the upper surface as an elliptical hydathode distant about 1 mm. from the apex; veins of the fertile segments once forked near the base, the thickened apex of each branch evident as a hydathode; sori nearly terminal upon the short proximal branch, round, arising about 0.7 mm. from the rachis and borne against it at maturity, then about 1.5 mm. in diameter; annulus consisting of 13 or 14 cells; spores subglobose, minutely granulate.

Type in the U. S. National Herbarium, no. 833632, collected upon the forested upper slopes of the Volcán de Barba, Costa Rica, February 6, 1890, by H. Pittier (no. 1928).

Polypodium hyalinum is a member of the group of *P. trichomanoides* and probably finds its nearest ally in that species itself, from which it differs not only in the general appearance of its fewer fronds and in having the segments broader, more oblique, and not at all gibbous, but also very manifestly in its rhizome scales. These have the cells larger and relatively much broader and with partition walls distinctly thicker than in *P. trichomanoides*. They differ further in having from 10 to 17 spreading fragile hyaline cilia set closely upon each side of the apical half, the scales of *P. trichomanoides* being wholly devoid of cilia. Several similar species of this group have ciliate scales, but in these the cilia are dark brown and mostly longer and bristle-like. *Polypodium hyalinum*, which takes its name from the transparent cilia of the rhizome scales, may thus be readily distinguished by this unique character alone. It doubtless occurs upon other of the Costa Rican volcanoes.

***Polypodium blepharodes* Maxon, sp. nov.**

Rhizome erect or ascending, about 1 cm. long, 2.5 mm. in diameter, abundantly radicose; fronds numerous, 8 to 15 cm. long, erect, closely fasciculate, subimbricate at the base and partially concealing the inconspicuous scales of the rhizome, these 1.5 to 2 mm. long, light ferruginous with slightly darker borders, lanceolate to narrowly oblong-lanceolate, acuminate, attached just above the rounded base, 7 to 12 cells broad in the basal portion, the inner cells acutely elongate, mostly polyhedral, thin-walled, 3 to 5 times as long as broad, the outer cells shorter, narrowly oblong, and with thicker partition and outer walls; scales provided with 12 to 15 very long slender stiff reddish brown spreading bristle-like cilia upon each side and a similar longer terminal bristle; stipes slender, 0.3 to 0.4 mm. thick, 5 to 15 mm. long, thickly beset with slender fragile spreading reddish castaneous hairs about 1.5 mm. long; lamina linear, 8 to 14 cm. long, 4 to 6 (rarely 8) mm. broad, pinnatifid at a right angle nearly to the rachis, gradually narrower at the short-attenuate lobate apex; segments monosorous, 40 to 50 pairs, spreading, only the lowermost 1 to 3 pairs smaller, broadly triangular, and strongly decurrent, the others oblong to deltoid-oblong, inequilateral, short-decurrent, obtuse or subobtuse, slightly apart (or apparently subdistant by the curvature of the margins in drying), entire or in larger specimens lightly gibbous near the middle; whole lamina strongly long-setose, especially upon the under surface (including the rachis), the hairs like those of the stipe; veins obscure, very oblique at the base, those of the sterile segments simple or forked, those of the fertile segments invariably forked in their basal third, the distal branch terminating in a conspicuous hydathode remote from the rounded apex of the segment, the fertile proximal branch

oblique, exceeding the sorus, terminating in a slender hydathode remote from the rachis; sori round, relatively large, lying against the rachis at maturity, distinct or (in small fronds) fully confluent; annulus consisting of 15 or 16 cells; spores subglobose, shallowly granulate.

Type in the U. S. National Herbarium, no. 575795, collected upon a stump at the edge of the forest near La Palma, Costa Rica, altitude 1,450 to 1,550 meters, May 6 to 8, 1906, by William R. Maxon (no. 406).

The following additional specimens are in the U. S. National Herbarium:

COSTA RICA: Cañas Gordas, alt. 1,100 meters, *Pittier* 10976, in part. Vallé de Agua Buena (Cañas Gordas), *Pittier* 10973. San Jeronimo, alt. 1,500 meters, *Wercklé* (Jimenez, no. 557). Also several specimens without exact locality, *Wercklé* (ex herb. Christ).

GUATEMALA: Forests near Coban, Alta Verapaz, alt. 1,350 meters, *von Türckheim* (J. D. Smith, no. 946). Vicinity of Cacao (between Panzós and Senahú), *Barber* 160.

Polypodium blepharodes belongs to the group of *P. trichomanoides* and apparently is most nearly allied to *P. daguense* Hieron. and *P. taenifolium* Jenman (*P. sintenisii* Hieron.). From the former species, known only from Colombia, it differs in its larger, narrower, and more freely ciliate rhizome scales, its differently shaped segments, and its much longer leaf bristles, and in having the veins forked far below their middle, the proximal branch being longer than in *P. daguense*. From the West Indian *P. taenifolium* it differs widely in the cellular structure and color of its rhizome scales, in its longer fertile veinlets, and in its smaller and differently shaped fronds which are more freely setose, the hairs also much longer.

In some respects *P. blepharodes* recalls the problematical *P. gibbosum* Fée, but that imperfectly described species, whose exact origin also is doubtful, is figured by Fée as having few pinnules, the lower ones very long-decurrent upon the rachis, and the annulus is said to have 11 or 12 cells; in none of which characters does *P. blepharodes* agree.

***Polypodium cookii* Underw. & Maxon, sp. nov.**

Rhizome erect, about 8 mm. long, 5 mm. in diameter, bearing 4 to 8 erect closely fasciculate fronds from 3 to 7 cm. long; scales of the rhizome borne in a relatively conspicuous terminal tuft, pale yellowish brown in mass, concolorous, about 1.5 mm. long, deltoid-lanceolate or narrowly deltoid-ovate, entire, devoid of cilia or marginal teeth, attached just above the rounded base, attenuate, terminating in a slender curved tip consisting of a single series of 3 or 4 oblong cells; scales 7 to 12 cells broad in the basal part, the cells broadly to narrowly oblong, uniformly lutescent, translucent, the partition walls darker optically, thin but very distinct; stipe up to 7 mm. long, subterete, 0.5 mm. thick, or sometimes obsolete, the rachis then narrowly alate to the base of the frond; lamina 3 to 6.5 cm. long, 3 to 5 mm. broad, linear or sometimes very gradually narrower in the apical half (the tip short, noncaudate, obtusely lobed), pinnatifid throughout to within 0.5 mm. of the rachis, the basal portion slightly narrowed, only the lowermost pair of segments broadly triangular and long-decurrent; segments monosorous, 15 to 30 pairs, close, slightly oblique, all but the basal pair broadly oblong, nearly equilateral, obtusely rounded, long-setose (like the whole lamina), the hairs reddish brown, 1 to 1.6 mm. long, especially numerous at the minutely crenulate apices of the segments and upon the lower side of the rachis; veins simple, terminating in a conspicuous elliptical hydathode remote from the apex of the segment, slightly arcuate at the base, or those of the fertile segments more strongly so, the sorus being borne upon a roundish receptacle at the upper side of the bend of the vein; sori roundish, a little more than 1 mm. in diameter, nearly basal, spreading against the rachis and confluent at maturity; annulus consisting of 14 cells; spores subglobose, shallowly granulate. Leaf tissue rigidly spongiose-chartaceous, glandular-

pubescent (especially beneath), the hairs bifurcate from a basal cell, one branch unicellular, the other 2-celled, the second (terminal) cell strongly clavate and gland-like.

Type in the U. S. National Herbarium, no. 407781, consisting of a single plant collected near the Finca Sepacuité, Alta Verapaz, Guatemala, March 20, 1902, by Messrs. O. F. Cook and R. F. Griggs (no. 80). A second (smaller) plant of the same collection is in the Underwood Fern Herbarium, New York Botanical Garden.

Polypodium cookii also is of the *P. trichomanoides* group, but is wholly unlike any of the American species thus far described. In its simple veins it is like *P. hartii* Jenman and *P. limula* Christ, but these species are otherwise very different in nearly all characters, especially in their very narrow fronds, in their oblique, elongate sori (which occupy nearly the whole vein), in the absence of very long hairs upon the lamina, and in the wholly different cellular structure of their rhizome scales. *Polypodium cookii* is probably more nearly related to those species of the *trichomanoides* group which have the fertile veins forked, but it differs from all of these in having the scales perfectly entire, as well as in its simple veins. The sorus is exactly sessile upon the upper side of the vein.

***Polypodium perpusillum* Maxon, sp. nov.**

PLATE 13, A.

Plants very small, apparently clustered. Rhizome decumbent, 5 to 8 mm. long, very slender, with a copious covering of relatively large spreading scales nearly throughout, these light brown in mass, 1.5 to 2.2 mm. long, narrowly oblong-lanceolate or deltoid-lanceolate from a rounded distinctly cordate base, acute, entire (without teeth or cilia), 12 to 17 cells broad in the somewhat concave basal portion, the cells oblong to linear-oblong, uniformly pale yellowish brown, translucent, the partition walls a little darker visually, thin; fronds several, subfasciculate (1 to 3 mm. apart), 2.5 to 4.3 cm. long, erect or toward the base arcuate, both stipe and lamina devoid of long bristle-like hairs; stipe 3 to 6 mm. long, 0.2 to 0.3 mm. thick, narrowly greenish marginate from a dark brown base; lamina linear, 2 to 4 cm. long, 2 to 3 mm. broad, throughout very obliquely pinnatifid almost to the rachis, glabrous above, a few appressed short turgid 3 or 4-celled gland-like hairs borne along the rachis beneath and upon the stipe; segments 7 to 16 pairs, alternate, the lower ones mostly sterile, narrowly deltoid-oblong, distant, long-decurrent, the fertile (monosorous) segments of the middle and upper lamina similar but closer, contiguous to slightly imbricate, arcuately oblong from a broadly adnate base, rounded-obtuse, often emarginate upon the distal margin above the sorus, then subspatulate; veins of the sterile segments mostly simple, terminating in a small but distinct dark hydathode (this equidistant from the three sides of the apex of the segment), or rarely forked at an acute angle just below the middle; veins of the fertile segments mostly simple, the sorus borne near the middle of the vein, the receptacle usually evident as a protuberance upon the upper side; sori round or suborbicular, less than 1 mm. in diameter, spreading against the rachis, distinct, or confluent only at maturity; annulus consisting of 14 or 15 cells; spores subglobose, very minutely roughened. Leaf tissue rigidly coriaceous, not at all translucent.

Type in the U. S. National Herbarium, no. 534909, collected in the Serra de Caraça, Minas Geraës, Brazil, March, 1892, by Ule; transmitted by Dr. H. Christ as *Polypodium setosum* Mett., which is *P. micropteris* C. Chr.

Polypodium perpusillum has little in common with *P. micropteris* and may be distinguished immediately not only by the shape of the lamina and of the segment but by the complete absence of bristle-like hairs. It is more nearly allied to the West Indian *P. grisebachii* Underw.; but that species differs widely in its rhizome scales, its flexuous rachis, its delicate, translucent leaf tissue, and its less oblique and broader, differently shaped segments, and especially in the position of its sori, these borne at or near the end of sharply defined slender branches.

***Polypodium shaferi* Maxon, sp. nov.**

PLATE 13, B.

Plants very small, the fronds several, ascending or subrosulate. Rhizome suberect, 5 mm. long, less than 2 mm. in diameter, much thicker from the presence of numerous rootlets and the bases of old fronds; scales of the rhizome inconspicuous, densely tufted, 1 to 1.5 mm. long, linear-oblong to oblong-lanceolate, attenuate, attached just above the rounded or subtruncate base, copiously long-ciliate (the cilia about 15 upon each side, close, averaging about 0.25 mm. long, very slender, whitish-hyaline, spreading, often curved), 7 to 9 cells broad near the base, the cells mostly elongate, irregularly polyhedral, the partition walls very dark reddish brown, greatly thickened, in the apical part of the scale often broader than the narrow lumen; stipe obsolete or wanting; lamina usually linear-oblongate, 1.5 to 3.5 cm. long, 2.5 to 4 (rarely 5) mm. broad, pinnately lobed about half way to the rachis, decidedly herbaceous-coriaceous, at first rather freely clothed above with stiff ascending simple yellowish hairs, these less than 0.5 mm. long, fragile and subpersistent, the under surface more freely pubescent, the hairs longer, paler, softer, and spreading; lobes or segments monosorus, 5 to 12 pairs below the obtuse crenate apex, oblique, rounded-deltoid, entire, mostly about 2 mm. broad at the base, the lower ones gradually shorter and broader, the lowermost pair evident only as low crenations, these long-decurrent (2 to 4 mm.) to the base of the frond; veins mostly forked at an acute angle in their lower third, the proximal branch fertile below its tip; sori roundish, about 1 mm. in diameter, extending against the rachis, confluent at maturity; sporangia freely long-setose, the hairs simple; annulus with about 13 cells; spores immature.

Type in the Underwood Fern Herbarium, New York Botanical Garden, collected from among moss on roots and rocks near Camp La Gloria, south of Sierra Moa, Province of Oriente, Cuba, December 24 to 30, 1910, by J. A. Shafer (no. 8071). Duplicate specimens of this collection are in the U. S. National Herbarium.

Polypodium shaferi finds its nearest ally unquestionably in *P. mitchellae* Baker, a species described from British Honduras, but now known also from Nicaragua and Guatemala¹ and, according to Christ, from Costa Rica.² It resembles that species in the cut of its fronds, in certain characters of its rhizome scales, and in its long-setose sporangia. It is very distinct specifically, however, in its lesser size, its coriaceous texture, its fewer, shorter, and broader lobes, its larger rhizome scales, and in the character and disposition of its pubescence. Young fronds in particular show many stiffish hairs upon the whole upper surface of the frond, whereas in *P. mitchellae* the pubescence of the upper side is almost confined to the midvein and is more sparse, the hairs longer, and much more slender.

The sharpest distinction between these two species, however, is observed in their rhizome scales; for, while the scales of both have numerous long, whitish cilia and are further similar in their greatly thickened, dense partition walls, they are wholly different in shape and size. The scales of the smaller species, *P. shaferi*, are elongate-oblong or oblong-lanceolate and measure from 1 to 1.5 mm. long. Those of the larger species, *P. mitchellae*, are minute (about 0.5 mm. long) and are either broadly deltoid or deltoid-ovate. These differences are very clear.

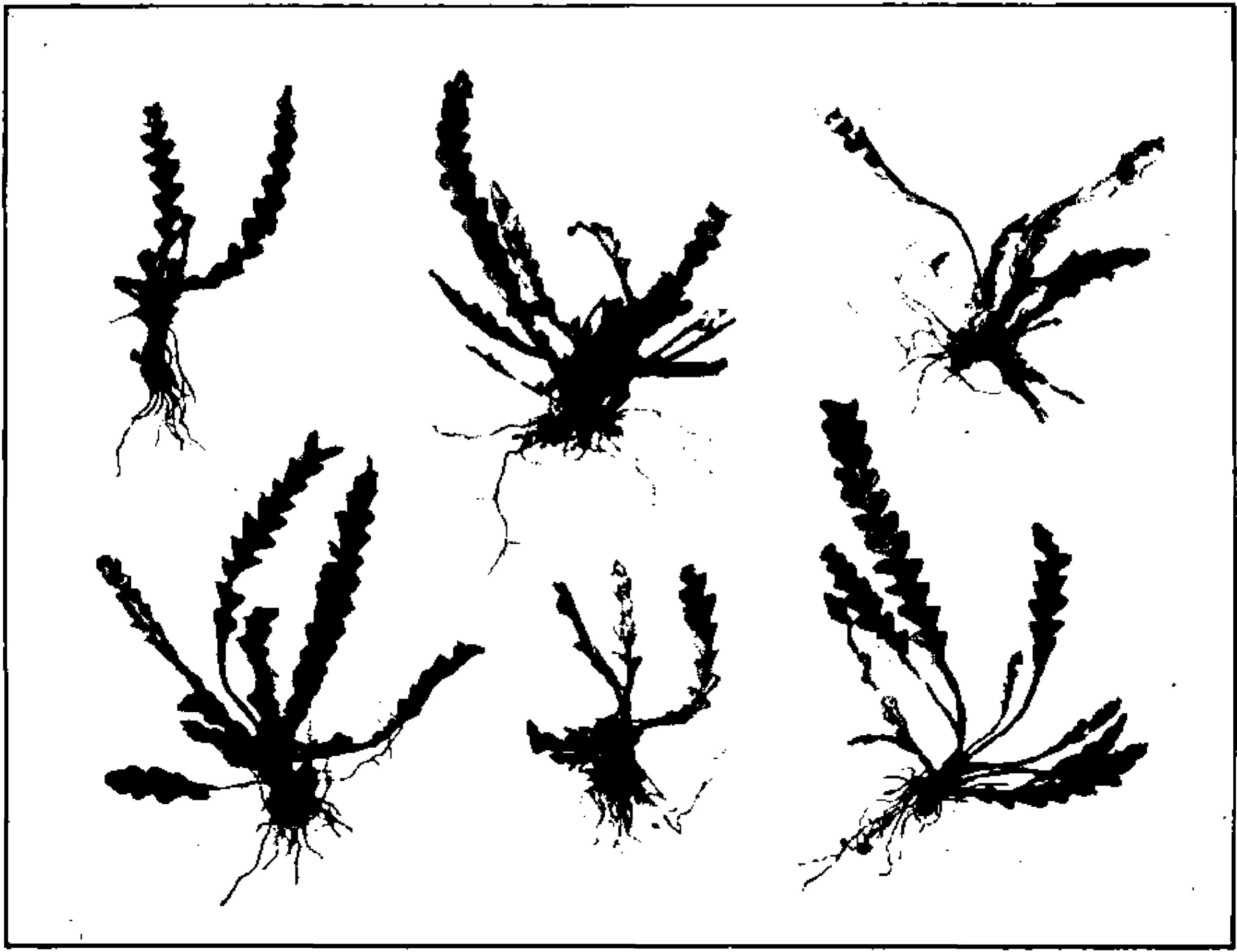
Polypodium shaferi and *P. mitchellae* are related to two South American species, *P. organense* (Gardn.) Mett. and *P. schenckii* Hieron. The last two have their rhizome scales similarly whitish-ciliate and with dark, greatly thickened partition cell walls; their sori, however, are not setose and the fronds of both are very unlike those of the two North American species in general appearance. Hieronymus, in describing *P. schenckii*, placed it in the small group of *P. serrulatum* Mett. (*P. duale* Maxon), but upon what possible ground it is hard to surmise. See page 406.

EXPLANATION OF PLATES 13, 14.—Plate 13, type specimens of (A) *Polypodium perpusillum* Maxon and (B) *Polypodium shaferi* Maxon. Natural size. Plate 14, specimens of *Polypodium mitchellae* Baker, collected near Secanquim, Alta Verapaz, Guatemala, altitude 450 meters, on mossy trunk of forest tree, January 7, 1905, by William R. Maxon and Robert Hay (no. 3195). Natural size.

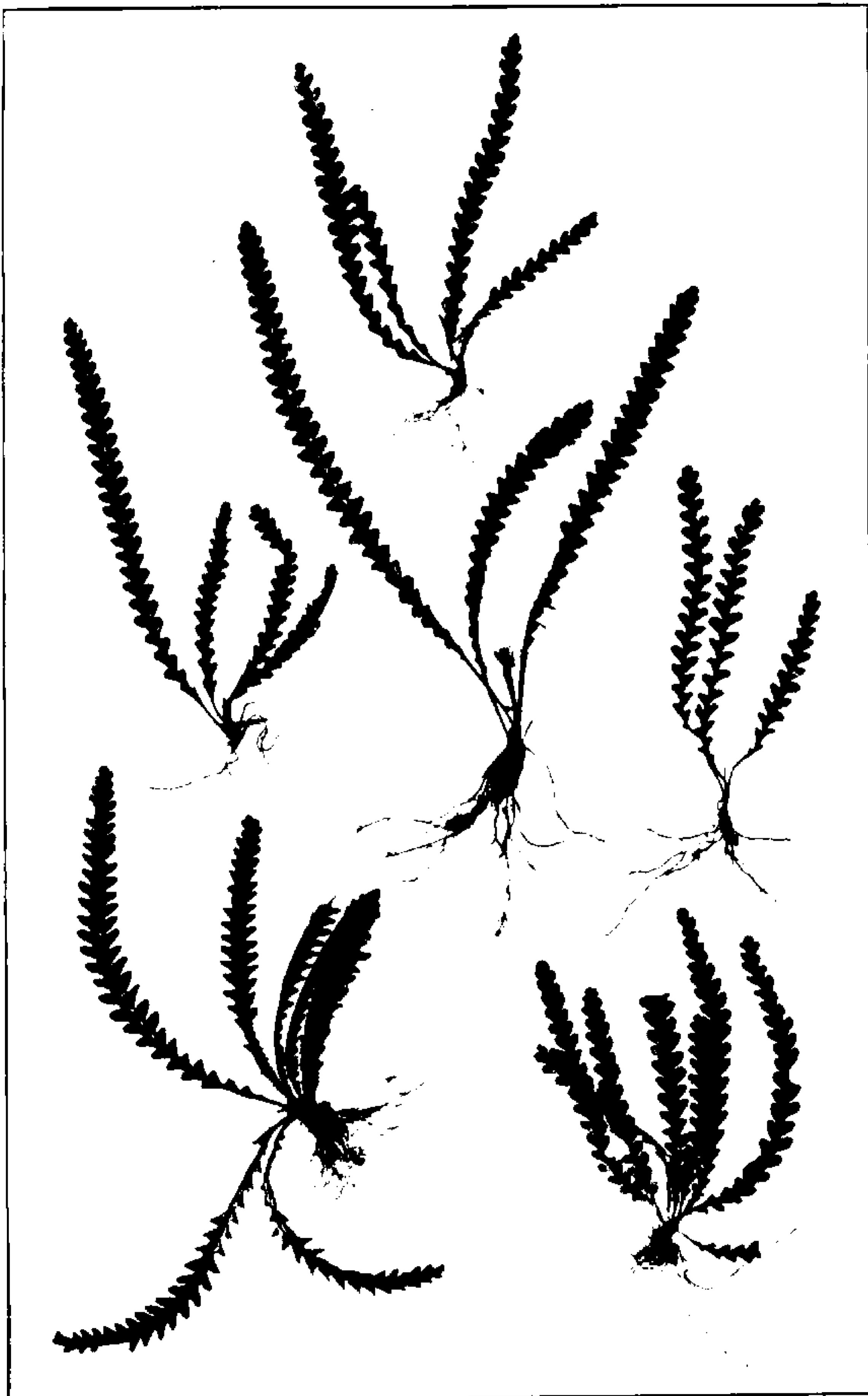
¹ Contr. U. S. Nat. Herb. 13: 43. 1909. ² Bull. Soc. Bot. Genève 1: 217. 1909.



A. POLYPODIUM PERPUSILLUM MAXON.



B. POLYPODIUM SHAFERI MAXON.



POLYPODIUM MITCHELLAE BAKER.

***Polypodium rosenstockii* Maxon, sp. nov.**

Plants epiphytic, with 8 to 12 pendent fasciculate fronds, 15 to 40 cm. long. Rhizome erect or oblique, 1 to 1.5 cm. high, about 5 mm. in diameter, freely radiceous below, the whole upper half conspicuously paleaceous, the scales yellowish brown (bright brown in mass), linear, rather lax, up to 6 mm. long, semitranslucent, subtortuous, somewhat plicate, the margins subentire, bearing an occasional minute unicellular gland-like process; stipes 1 to 3 cm. long, 0.5 to 0.7 mm. thick, dull light brown, terete, bearing a few very slender yellowish hairs about 2 mm. long, these readily deciduous; lamina oblanceolate (in small plants) to linear, 12 to 38 cm. long, 2 to 3.2 cm. broad, subpinnatisect throughout, gradually attenuate toward the base, usually more abruptly so toward the short-caudate apex; pinnules 15 to 65 pairs entire, spreading or slightly oblique, the lowermost ones very broadly so, short-decurrent, almost vestigial, often far apart; pinnules in general narrowly triangular-oblong, slightly decurrent to the narrowly acute sinus, connected by a costal wing less than 1 mm. broad; midvein slightly flexuous, medial except at the arcuate base, here parallel to the lower margin; veins 8 to 12 pairs, very oblique, wholly immersed, evident only by transmitted light, mostly once forked at or beyond their middle; sori 7 to 10 pairs, superficial, terminal upon the short distal branches, much nearer to the margin than to the midvein, round, about 1 mm. in diameter; sporangia glabrous, the annulus with 14 cells; spores triplanate, pale, minutely granulate. Leaf tissue very rigidly spongiose-herbaceous, freely but minutely viscid-glandular beneath, sparingly so above.

Type in the U. S. National Herbarium, no. 692068, collected near Caldas, Minas Geraës, Brazil, in 1851 and distributed as no. 1442 of Series III of the Regnell Herbarium under the name *Polypodium pendulum* Swartz.

The following additional collections, both representing younger but fully fertile plants and both distributed as *P. pendulum*, are in the U. S. National Herbarium.

BRAZIL: Serra do Mar, São Paulo, alt. 1,000 meters, *Wacket* (Rosenstock, nos. 288 and 439.)

Although the type number of this species was distributed long ago as *Polypodium pendulum* Swartz and was subsequently listed under that name,¹ it can scarcely be regarded as a near relative of that species, which may be identified readily by means of Schkuhr's excellent plate² and Jenman's very good description.³ *Polypodium pendulum*, which is probably confined to the West Indies, differs wholly in its slender, lax, delicate fronds, short, distant pinnules, rigidly long-setose sporangia, and long-ciliate, conspicuously reticulate rhizome scales.

Polypodium rosenstockii is allied rather to *P. curvatum* Swartz, which differs specifically in the much greater size of all its parts, in its exstipitate fronds, in its thicker and decidedly whitish pulverulent leaf tissue, and in its rigidly short-ciliate rhizome scales, as well as in numerous other characters.

Both *P. pendulum* and *P. curvatum* are represented in the National Herbarium by very complete material which was collected by the writer in Jamaica, the type locality, and was compared with Swartz's types at Stockholm by Dr. Lindman. The latter species was described and figured by Fée as *Polypodium inaequale* Fée.⁴

NOTE UPON PELLAEA ARSENI.

This species, described⁵ by Christ from a single collection (*Arsène* 2496), is a common one in Mexico, whose distinctness had long been recognized by Dr. L. M. Underwood and the writer, independently

¹ Arkiv Bot. 1: 231. 1903.

⁴ Mém. Foug. 11: 47. pl. 12. f. 3. 1866.

² Krypt. Gewächs 1: pl. 10. 1804.

⁵ Not. Syst. 1: 233. 1910.

³ Bull. Bot. Dept. Jamaica II. 4: 118. 1897.

of each other. In fact, a considerable number of specimens collected by Dr. Edward Palmer and Dr. J. N. Rose had been distributed under another manuscript name given by the writer in honor of the latter. Of the earlier collections by other botanists some were distributed as *Cheilanthes microphylla* Swartz and others as *Pellaea seemanni* Hook. The resemblance of *Pellaea arsenii* to certain states of the former species is rather pronounced; but it bears little likeness to *P. seemanni*, with which, however, it apparently often grows immixed.

The following specimens, all from Mexico, are in the U. S. National Herbarium:

FEDERAL DISTRICT: Valley of Mexico, *Schaffner* 96, 97. Near Guadalupe, *Rose & Painter* 6531. Near Tlalpam, *Rose & Painter* 6463, 9463, 11039. Lava fields near Tlalpam, *Pringle* 9284, 11271.

QUERÉTARO: Near San Juan del Río, *Rose, Painter & Rose*, 9505. Near Querétaro, *Rose & Rose* 11177.

JALISCO: Near Chapala, *Rose & Painter* 7668. Río Blanco, *Edw. Palmer* 732 in 1886.

DURANGO: Otinapa, *Edw. Palmer* 356 in 1906. Tejamén, *Edw. Palmer* 507 in 1906. Vicinity of Durango, *Edw. Palmer* 551 in part, 887, 888, all in 1896.

CHIHUAHUA: Dry rocky slopes, Sierra Madre, *Pringle* 1443. Without special locality, *Edw. Palmer* 87 in 1885.

OAXACA: Near San Luis Tultitlanapa, Puebla, near Oaxaca, *Purpus* 3148.

SAN LUIS POTOSÍ: San Luis Potosí, *Parry & Palmer* 979.

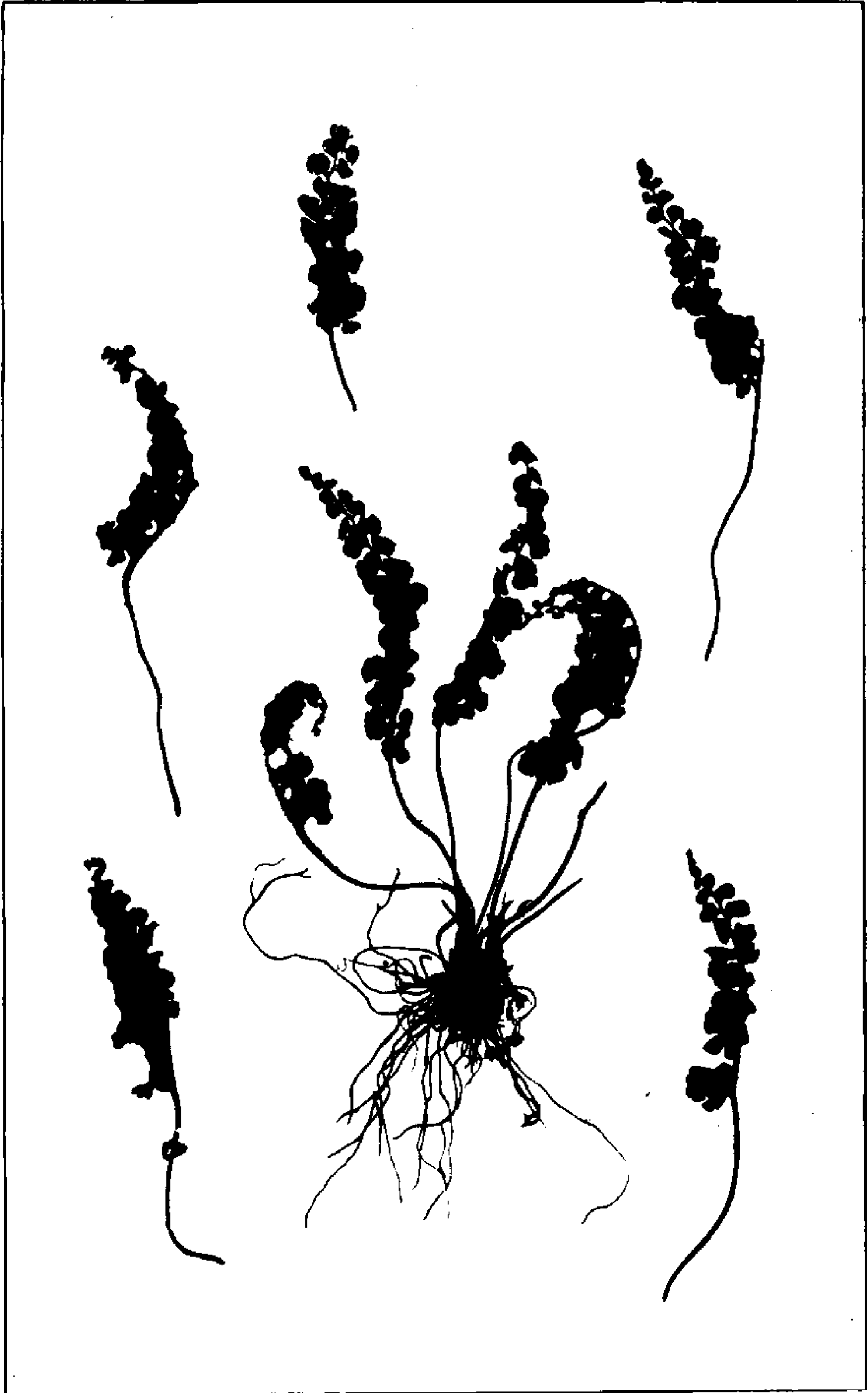
A NEW PSILOGRAMME FROM PORTO RICO.

Among a small collection of ferns received from Porto Rico not long ago is the following undescribed species of *Psilogramme*, a genus not reported hitherto from the West Indies.

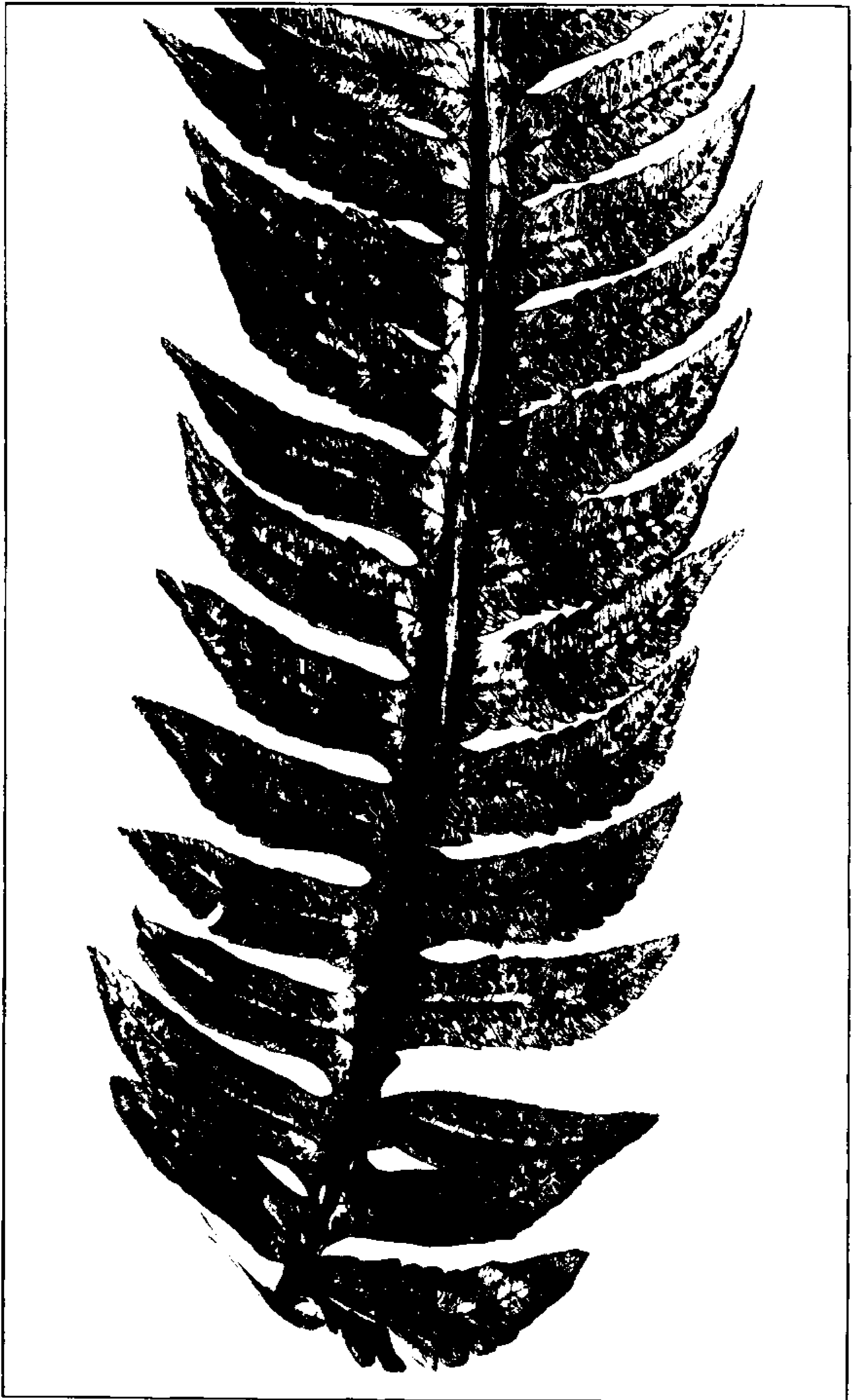
Psilogramme portoricensis Maxon, sp. nov.

PLATE 15.

Plants small, not more than 7 or 8 cm. high. Rhizome erect, about 8 mm. high, 5 mm. in diameter, coarsely radicle below, the apex bearing numerous straight, turgid, sharply acicular, dark castaneous, 12 to 18-celled hairs 1.5 to 2 mm. long; fronds 6 or 8, erect or ascending, arcuate or subflexuose, long-stipitate, 5 to 7 cm. long; stipe 2.5 to 3.5 cm. long, 0.5 to 0.8 mm. thick, dark castaneous, convex dorsally, deeply sulcate ventrally, at the base bearing a few hairs like those of the rhizome, above this densely hispid with flaccid few-celled simple yellowish brown hairs, these subpersistent; lamina lanceolate, acuminate, 2.5 to 3.5 cm. long, 9 to 14 mm. broad in the lower half, subbipinnate in the basal part, the dark rachis clothed like the stipe, the rigidly herbaceous segments strongly hispid upon both surfaces with greenish stramineous, stiffish, flattish, spreading, few-celled hairs; pinnae about 7 to 9 pairs below the acuminate simply lobate apex, the lowermost 2 or 3 pairs deltoid, ternately divided, the two basal segments nearly free, orbicular-obcordate, crenate, the terminal segment larger, asymmetrical, irregularly lobed, the lobes crenate; upper pinnae asymmetrical, broadly oblong to suborbicular, with a single rounded adnate basal auricle upon the distal side, or the uppermost ones simple; veins dichotomous, 2 to 6 ultimate branches to each segment, terminating far from the margin, sporangiate nearly throughout their length, the sori thus linear, confluent at maturity and partially concealed by the widely concave margins of the segments; spores triplanate, rounded-triangular, granulate, with a single wide smooth wing; annulus consisting of 18 or 19 cells.



PSILOGRAMME PORTORICENSIS MAXON.



HEMITELIA RUDIS MAXON.

Type in the U. S. National Herbarium, no. 697769, collected at the extreme summit of El Yunque Mountain, Porto Rico, altitude about 1,110 meters, March, 1912, by Brother Hioram (no. 348).

This new member of the genus *Psilogramme* is one of a small group of species in which the veins do not reach the margin, and of a still smaller section characterized by having several veinlets to each ultimate segment. Out of the 4 or 5 species comprising this last subgroup it is related at all closely only to *P. hispidula* (Klotzsch) Kuhn, a South American species which is known to the writer from Kunze's illustration¹ and a single Colombian specimen in the U. S. National Herbarium. *Psilogramme portoricensis* is about one-third the size of *P. hispidula* and differs widely otherwise in the shape and subdivision of its pinnae and in its much more copious hispid covering throughout, particularly upon the lamina.

EXPLANATION OF PLATE 15.—Type specimens of *Psilogramme portoricensis*. Natural size.

A NEW SPECIES OF HEMITELIA, SECTION CNEMIDARIA, FROM PANAMA.

A further examination of material collected in Panama has led to the conclusion that the form here described is entitled to recognition as distinct from the species previously treated by the writer in a revision of the North American species of *Hemitelia*, section *Cnemidaria*.² Its relationship is discussed below.

Hemitelia rudis Maxon, sp. nov.

PLATE 16.

Rhizome short, erect, mostly subterranean; fronds several, erect-spreading, 2 to 2.5 meters long; stipes stout, about 80 cm. long, deeply sulcate, pale brownish, closely arachnoid-furfuraceous, distantly and sharply low-tuberculate, scantily paleaceous, the scales deciduous, appressed, with glossy dark brown centers and broad whitish fimbriate margins; lamina 1.2 to 1.7 meters long, 60 to 80 cm. broad, oblong-lanceolate, deeply bipinnatifid, the rachis similar to the stipe but not tuberculate; pinnae about 17 pairs below the abruptly acuminate apex, subopposite or mainly alternate, inserted 7 to 13 cm. apart on each side, the larger ones linear-lanceolate, 30 to 40 cm. long, 5 to 8.5 cm. broad, sessile, spreading, scarcely or not at all reduced at the inequilateral base, at the lower side rounded and often slightly imbricate upon the rachis, at the upper side parallel to the rachis, pinnatifid to within 2 or 3 mm. of the costa in the basal part, the costal wing broader outward, about 5 mm. broad on each side below the gradually long-acuminate, often attenuate apex; costae stout, together with the costules deciduously arachnoid-pubescent beneath and bearing occasional appressed broad flattish delicate pale scales; segments of middle pinnae 20 to 25 pairs, linear-oblong, acuminate to long-acuminate, slightly dilatate, 7 to 14 mm. broad, approximate to distinctly apart, falcate or subfalcate, coarsely crenate-serrate, the subimbricate proximal basal segment usually lobed upon the proximal margin; veins all free, evident, glabrous above, distinctly setulose beneath, once or twice forked, or the larger ones with 2 or 3 pairs of subopposite arcuate lateral branches; sori approximate, mostly inframedial, borne upon the lower branches of the veins at or near their base, or rarely submedial by the production of an imperfect second row upon the second row of branches; indusium rather small, semicircular, subcucullate or repand, crenately lobed, fragile; receptacle ovoid, minutely pubescent. Leaf tissue rigidly herbaceous, dark green above, much lighter below.

Type in the U. S. National Herbarium, nos. 670388-391, consisting of a single frond taken from a plant growing in the humid forest of the upper Caldera watershed,

¹ Kunze, Farnkr. 1: pl. 82. 1846. ² Contr. U. S. Nat. Herb. 16: 25-49. 1912.

between "Camp I" and the Divide, Holcomb's trail, above El Boquete, Chiriqui, Panama, altitude about 1,750 meters, March 23, 1911, by William R. Maxon (no. 5682). Additional data are derived from other mounted specimens of the same number.

In the venation of its largest pinnae *Hemitelia rudis* shows some approach to *H. grandis*, though it differs from that species conspicuously in leaf shape, in its much lesser size and degree of subdivision, and in its crenate-serrate (not crenately lobed) segments. It is more nearly related to *H. subglabra* of Costa Rica, but differs in venation and in its coarsely crenate-serrate (instead of subentire to lightly undulate-serrate) margins. The deeply lobed proximal basal segments, overlying the rachis, recall the West Indian *H. grandiflora*,¹ a species with which it has no close connection.

EXPLANATION OF PLATE 16.—Basal portion of a pinna of the type collection. Natural size.

THE NORTH AMERICAN SPECIES OF HEMITELIA, SECTION EUHEMITELIA.

In a previous paper² of this series the writer, in the course of a brief review of the taxonomic history of *Hemitelia*, expressed the view that two fairly distinct sections of the genus might properly be recognized: "(1) *Euhemitelia* and (2) *Cnemidaria*; the first, embracing large species of truly arboreal growth, with mainly tripinnatifid fronds and narrow, often rather minute segments; the latter, plants which are scarcely arborescent, with ample, pinnate to bipinnatifid (or rarely tripinnatifid) fronds, the leafy parts broad and little dissected."

The North American species of the section *Cnemidaria* were treated in that paper, eight out of the eighteen there recognized being described as new. There were included also notes upon three species known only from South America and comments upon five doubtful species described long ago from various parts of tropical America. In the present paper the North American representatives of the typical section of the genus, *Euhemitelia*, will be similarly treated. The type species is *H. multiflora* (J. E. Smith) R. Br.

It must be admitted that *Euhemitelia* is not an especially homogeneous group and that, leaving the indusia out of consideration, its species might be placed in either *Cyathea* or *Alsophila* without great violence. Having regard to the indusia, moreover, a close interrelationship of its species is even less evident, since this structure has assumed several very diverse forms. Thus, although *Hemitelia multiflora* shows indusia very like those of the species of section *Cnemidaria*, other species (for example, *H. sessilifolia*, *H. sherringii*, and *H. muricata*) have the indusia deeply cleft and more or less perfectly deciduous, and in *H. costaricensis* the subdivision is carried even further. On the other hand, *Hemitelia wilsoni* has more than a few of its indusia of a subcyathiform type; that is, extending more

¹ See Contr. U. S. Nat. Herb. 16: 41. 1912.

² Contr. U. S. Nat. Herb. 16: 26. 1912.

than halfway around the base of the receptacle and nearly forming a shallow cup, thus approaching the form which distinguishes several of the species of *Cyathea*, section *Eucyathea*. The transition from a delicate, fragile, deeply splitting indusium like that of *Hemitelia muricata* to the mere vestigial scale observed in the Jamaican *Alsophila parvula* and the Australasian *Alsophila australis* (which is the type species of *Alsophila*), and further to the complete absence of even a vestigial scale, is not a very great step, and there are several species whose ready reference to one genus or the other requires good material. Whether there is warrant for giving so much weight to indusium characters in the distinction of the genera is open to question. The writer, as heretofore explained, has preferred to follow the usual practice. In any case these characters are fairly constant for the species and upon careful examination are very useful in distinguishing them.

KEY TO THE SPECIES.

- Lamina bipinnate, the pinnules serrate-crenate to barely pinnatifid.
- Pinnæ 20 to 24 cm. long; pinnules deeply serrate-crenate.... 1. *H. elliottii*.
 - Pinnæ 40 to 60 cm. long; pinnules mostly pinnatifid about halfway to the costa.
 - Indusia brown, dimidiate, deeply lacerate-fimbriate, the divisions slender, fragile, fugacious..... 2. *H. sessilifolia*.
 - Indusia much larger, whitish, saccate or subcyathiform, subentire or shallowly lobed, persistent. 3. *H. wilsoni*.
- Lamina very deeply tripinnatifid.
- Sori inframedial, often borne close to the costa.
 - Segments 12 to 14 pairs, distant, the sinuses obtuse..... 4. *H. sherringii*.
 - Segments 20 to 23 pairs, approximate, the sinuses sharply acute.
 - Indusia conspicuous, bullate, erose or shallowly cleft. 5. *H. calolepis*.
 - Indusia obscure, deeply cleft, the divisions lacerate to filamentous..... 6. *H. costaricensis*.
 - Sori medial or distinctly supramedial.
 - Larger pinnules about 13 pairs per pinna..... 7. *H. escuquensis*.
 - Larger pinnules 18 to 25 pairs per pinna.
 - Indusia small, shallowly lobed, persistent..... 8. *H. multiflora*.
 - Indusia large, very deeply cleft into several long slender segments, these fugacious..... 9. *H. muricata*.

1. *Hemitelia elliottii* (Baker) Underw. MS.

Alsophila elliottii Baker, Annals of Botany 6: 96. 1892.

Caudex said to be very short; fronds 90 to 120 cm. long; stipe 30 cm. long, armed with spreading sharp spines, divested of scales with age; lamina subdeltoid, 60 to 90 cm. long, bipinnate, the primary rachis mottled reddish brown, slightly rough, glabrescent; pinnæ narrowly oblong-lanceolate, 20 to 24 cm. long, 5 to 6 cm. broad, subsessile, long-acuminate, the secondary rachis stout, reddish, distantly muricate, glabrescent, very delicately and inconspicuously foliaceo-marginate except at the base; pinnules about 20 pairs, linear-oblong, 2.5 to 3 cm. long, 7 to 9 mm. broad, deeply serrate-crenate, approximate to subdistant, sessile, or those toward the apex semiadnate, the apical ones fully adnate and decurrent; costules stout, elevated,

bearing an occasional distant flattish or subbullate pale brownish scale; major veins about 8 pairs per pinnule, each with 3 to 5 pairs of simple oblique branches to each crenation, the lowermost pair of branches extending to the sinus; sori very few, small, medial; indusium proximal, small, dimidiate, light brown, somewhat erose; receptacle minutely squamulose-pilose.

TYPE LOCALITY: Antoine, Bellevue, Grenada (*Elliott*).

DISTRIBUTION: Known only from the mountains of Grenada.

Hemitelia elliotii is here redescribed chiefly from a specimen so named in the Jenman collection (acquired by the New York Botanical Garden in 1903) and marked as coming from Grenada, the collector's name not specified. The general appearance of the plant, its smaller size, and its nearly sterile condition all lead to the suspicion that it may be a juvenile form of some other species. There is, however, no hint of identity with *Hemitelia wilsoni* Hook., to which species it was referred by Jenman.¹ In the character of its few scales it suggests relationship with *Hemitelia sessilifolia*, but it is more likely to prove a reduced or juvenile form of some South American species.

2. *Hemitelia sessilifolia* Jenman, Ferns Brit. W. Ind. Guian. 44. 1898. PLATE 17.

Alsophila sessilifolia Jenman, Journ. Bot. 20: 325. 1882.

TYPE LOCALITY: Mansfield, near Bath, Jamaica (*Wilson* 520).

DISTRIBUTION: Known only from the original collection.

The specimens upon which this species was described are preserved at Kew and in the British Museum. The writer has received from the latter institution a photograph and pinnule of the type and has examined two additional complete specimens in the Underwood Fern Herbarium, New York Botanical Garden, apparently of the original collection by Wilson. These indicate a species similar to the larger states of *Hemitelia wilsoni* in cut of leaf, but differing in the characters noted under that species. Jenman, though listing and describing *sessilifolia* as distinct from *wilsoni*, nevertheless states that "it is probably a non-indusiate state of *wilsoni* Hook., which it very much resembles in the largest states." *Hemitelia sessilifolia* is not, however, non-indusiate. The indusia, as made out from a pinna of the type collection preserved in Jenman's own collection (since acquired by the New York Botanical Garden), have been described by the writer (in manuscript for the North American Flora) as "brown, proximal, dimidiate, deeply lacerate, the divisions fimbriate, fragile, only the broader basal portions usually persistent, or these tardily deciduous." They are thus very different from the indusia of *H. wilsoni* but not very unlike those of *H. muricata*, a species which is not closely allied to it.

EXPLANATION OF PLATE 17.—Section of a primary pinna in Underwood Fern Herbarium, collected by Wilson and apparently a part of the original collection. Natural size.

3. *Hemitelia wilsoni* Hook. in Hook. & Baker, Syn. Fil. 30. 1865. PLATE 18.

TYPE LOCALITY: Mansfield, near Bath, Jamaica (*Wilson* 731).

DISTRIBUTION: Mountains of Jamaica and Porto Rico, at 300 to 900 meters altitude; rare.

The present species is one of the most peculiar tree ferns of the West Indies and probably one of the rarest. It was first collected by Wilson in some part of eastern Jamaica near Mansfield, a region which has yielded several other new and as yet little known species of Cyatheaceae. According to Jenman it has since been collected in Jamaica by Syme, Sherring, and Hart near Mount Moses and Claverty Cottage. Jenman includes Grenada in its range also, but the specimens so referred appear to represent a distinct species, *Hemitelia elliotii*, described by Baker.

The relationship of *Hemitelia wilsoni* is with *H. sessilifolia*, but it differs somewhat in cut of leaf and very noticeably in its large whitish (not lacerate nor brownish) indusia, as well as in its rather numerous, large, subpersistent, flat, appressed, whitish

¹ Ferns Brit. W. Ind. Guian. 44. 1898.



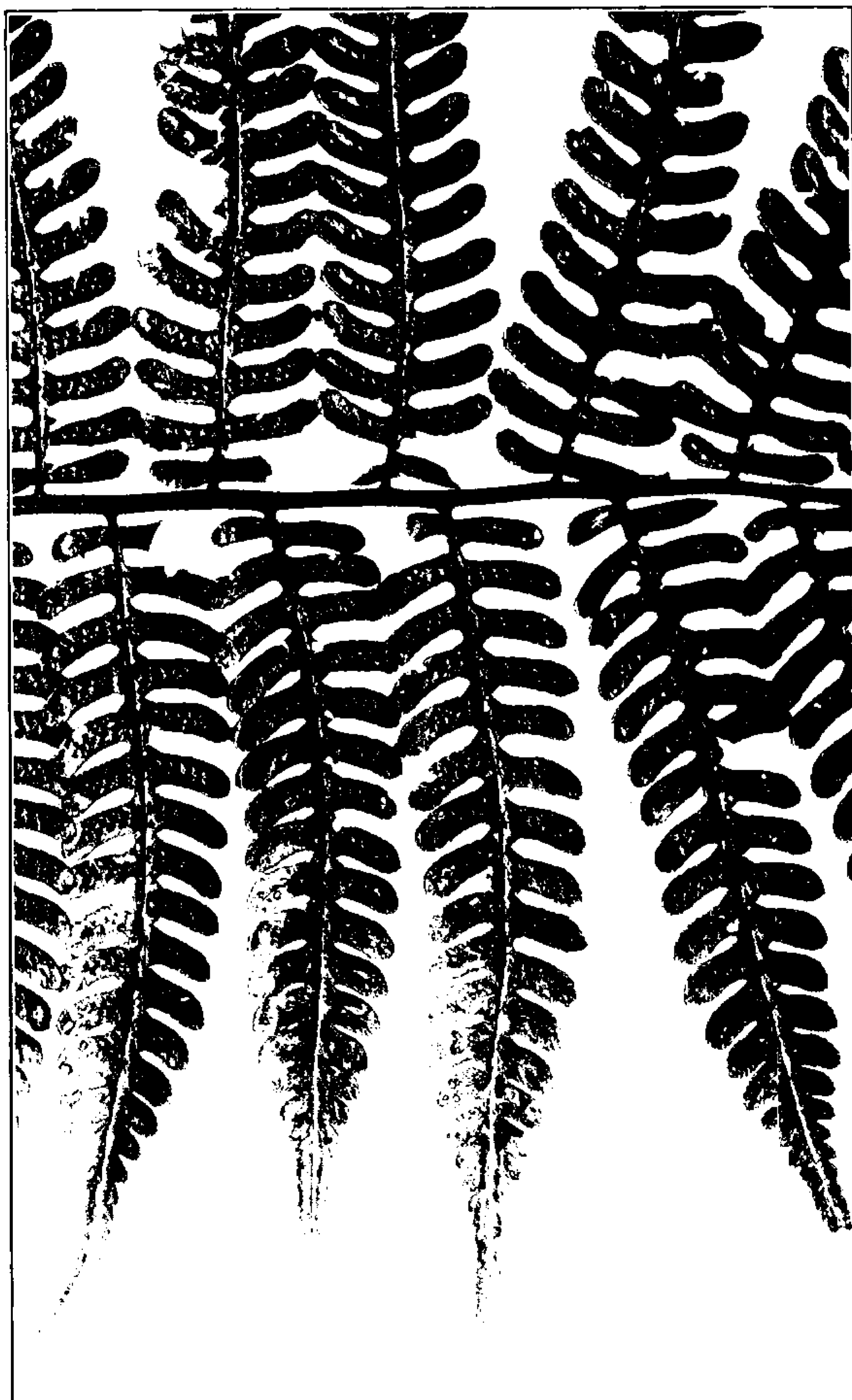
HEMITELIA RUDIS MAXON.



HEMITELIA SESSILIFOLIA JENMAN.



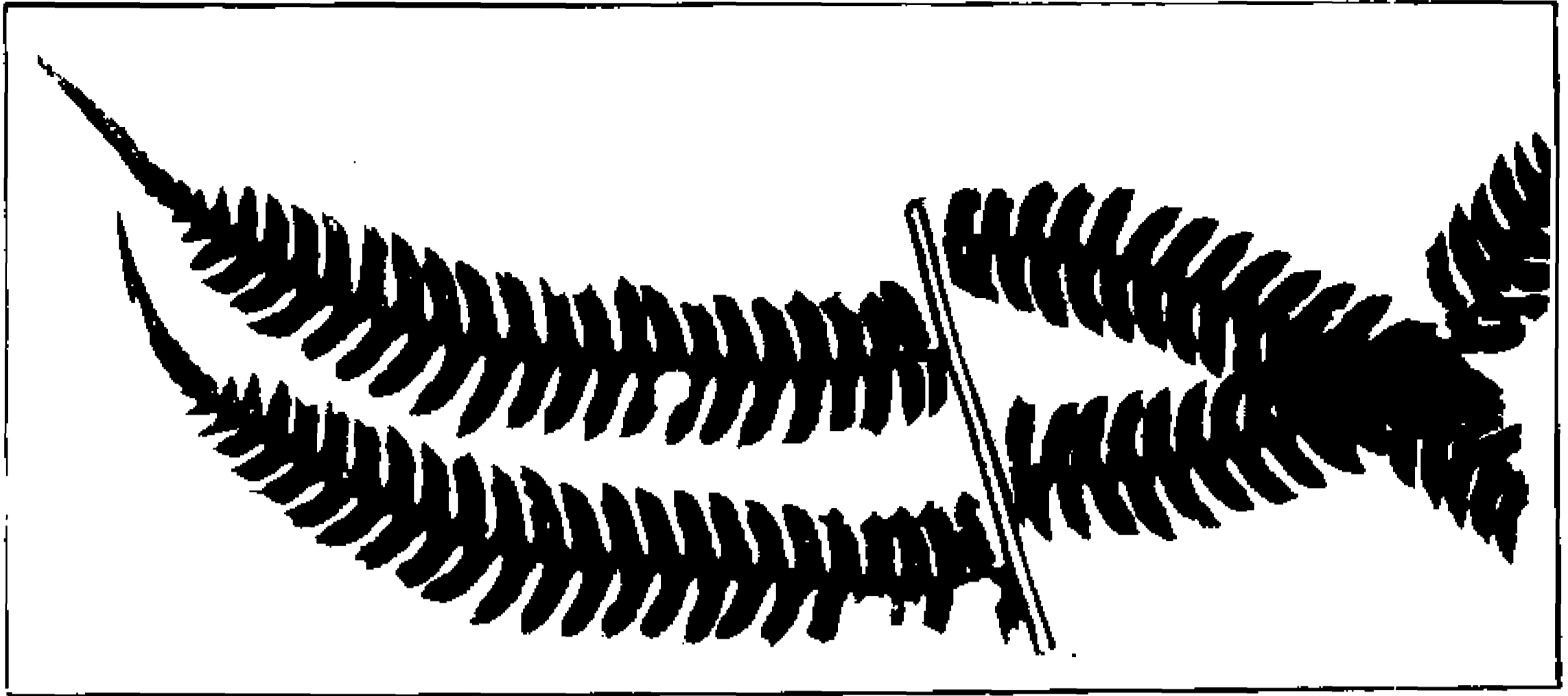
HEMITELIA WILSONI HOOK.



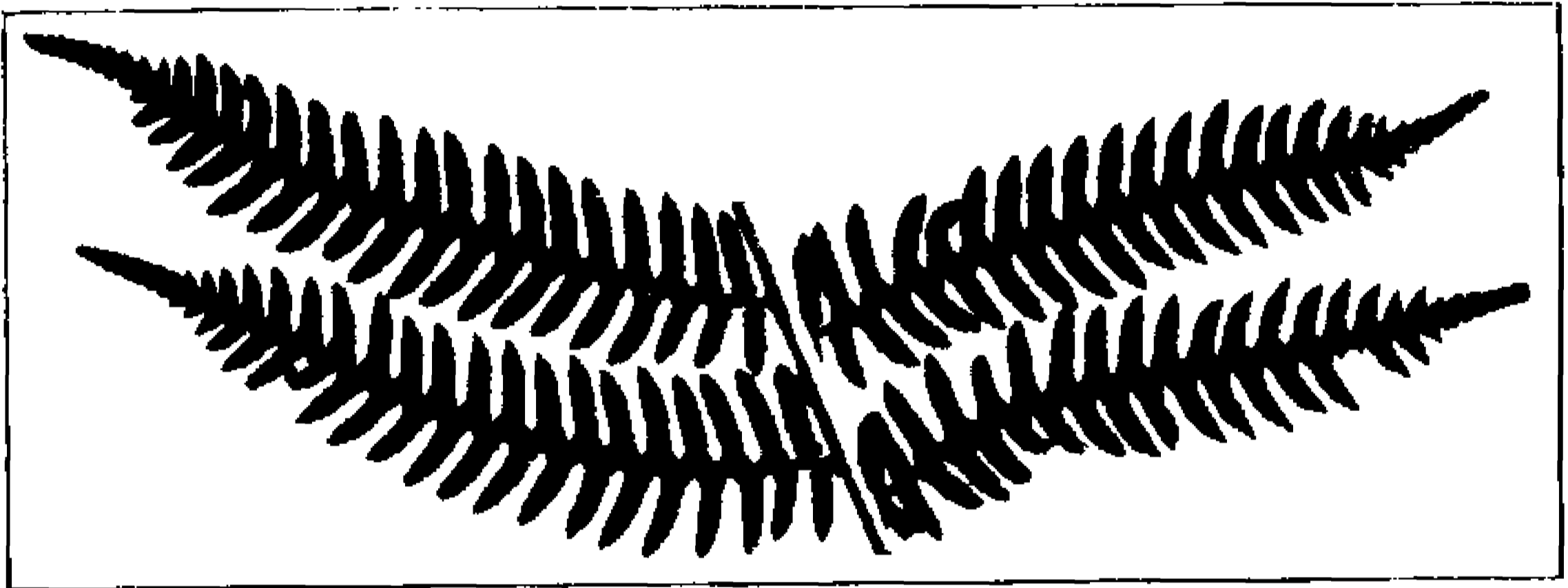
HEMITELIA SHERRINGII JENMAN.



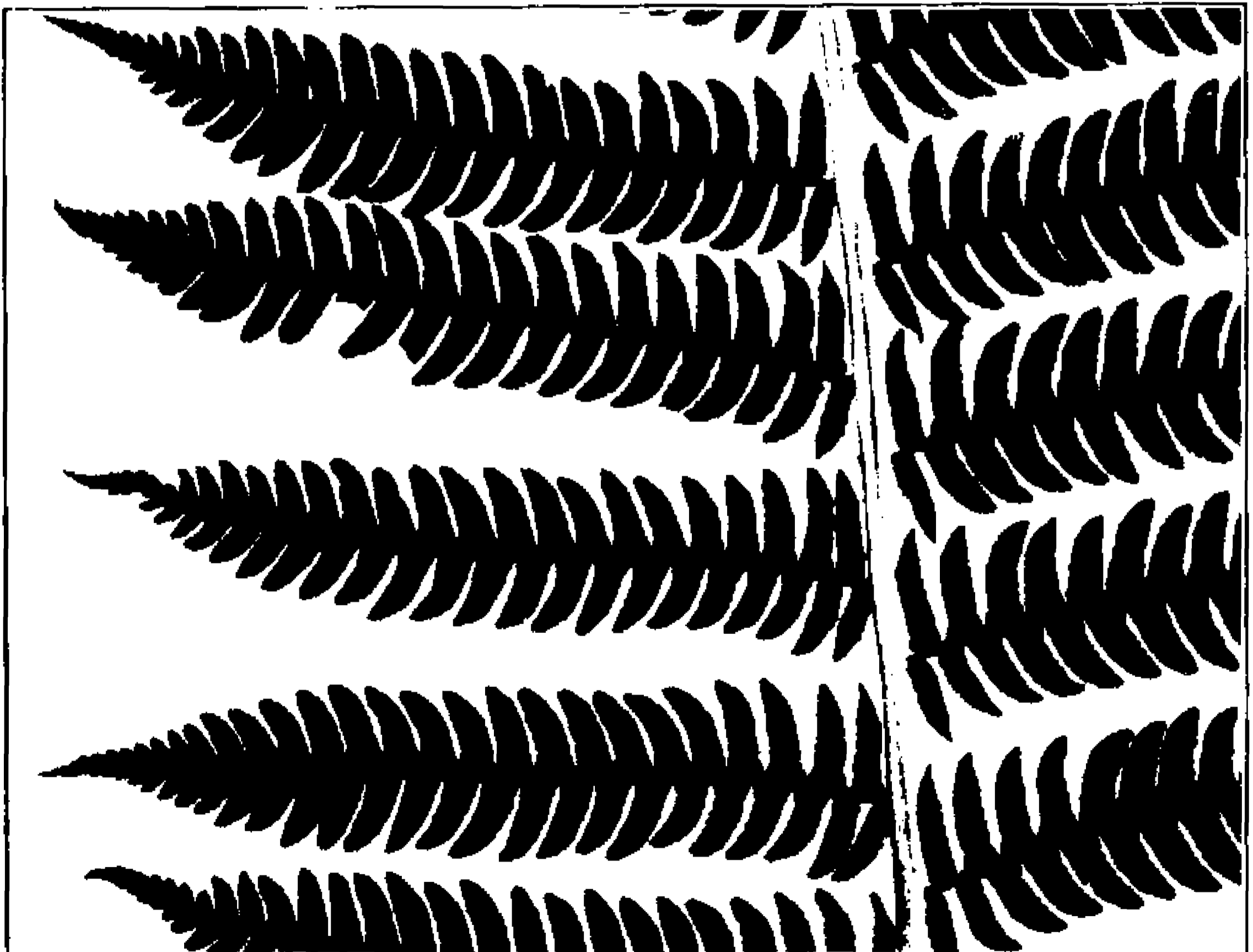
HEMITELIA CALOLEPIS HOOK.



A. HEMITELIA COSTARICENSIS (KLOTZSCH) METT.



B. HEMITELIA COSTARICENSIS (KLOTZSCH) METT.



C. HEMITELIA COSTARICENSIS (KLOTZSCH) METT.

scales upon the under side of the costæ. The few scales which occur similarly in *Hemitelia sessilifolia* are small and brownish.

The Porto Rican record, which is a new one, relates to specimens collected at Finca Alvarez, January 4, 1913, by Brother Hioram (no. 182). These are unusual in showing a short transverse veinlet occasionally connecting the lowest vein of each group to a similar vein of the next. This feature is not evident in Jamaican specimens, of which there are several in the Underwood Fern Herbarium, collected by Wilson, and two in the National Herbarium, the collector's name of the latter not given. These accord perfectly with a fragment of the type in the D. C. Eaton Herbarium and with a photograph of the type, received from Kew.

EXPLANATION OF PLATE 18.—Basal section of a primary pinna in the Underwood Fern Herbarium collected by Wilson and presumably a part of the original collection. Natural size.

4. *Hemitelia sherringii* Jenman, Journ. Bot. Brit. & For. 24: 266. 1886. PLATE 19.

TYPE LOCALITY: Rose Hill, Port Royal Mountains, Jamaica, altitude about 1,200 meters.

DISTRIBUTION: Known only from the type locality.

According to Dr. L. M. Underwood's unpublished notes this species is known only from a single plant, growing in the Port Royal Mountains, Jamaica, from which Mr. R. V. Sherring collected specimens in 1886. Pinnæ of this collection are at Kew, in the Underwood Fern Herbarium of the New York Botanical Garden, and in the U. S. National Herbarium.

EXPLANATION OF PLATE 19.—Portion of a pinna of the type collection, in the U. S. National Herbarium. Natural size.

5. *Hemitelia calolepis* Hook. in Hook. & Baker, Syn. Fil. 29. 1865. PLATE 20.

TYPE LOCALITY: Monte Verde, Province of Oriente, Cuba.

DISTRIBUTION: Known only from the original collection (*Wright* 950).

A strongly marked species somewhat suggesting certain lax states of *Cyathea arborea*. The small roundish, whitish, bullate scales, which occur sparingly upon the costæ and abundantly upon the costules, are characteristic. Specimens of the original collection have been examined in several herbaria.

EXPLANATION OF PLATE 20.—Section of primary pinna in herb. D. C. Eaton. Natural size.

6. *Hemitelia costaricensis* (Klotzsch) Mett.; Kuhn, Linnaea 36: 159. 1869.

PLATE 21.

Cyathea costaricensis Klotzsch; Kuhn, Linnaea 36: 159. 1869, as synonym.

TYPE LOCALITY: Costa Rica or Veraguas, Panama.

DISTRIBUTION: Vera Cruz to Panama, ascending to 1,000 meters.

Although *Hemitelia costaricensis* shows wide variation in size the differences are no greater than might be looked for in a species covering so wide a range. The original specimens, collected by Warscewicz (nos. 36 and 197) in "Costa Rica and Veragua," have the appearance of being decidedly xerophilous for a tree fern; and it is interesting to note that the Guatemalan specimens cited below are all from the drier, western part of that country and that the Santa Rosa specimens in particular, which in their lesser size perfectly match the original, are from a region which, in fact, may even be called semiarid. Few tree ferns are able to exist in such surroundings.¹ In the more humid region of Vera Cruz, Mexico, individuals of this species are uniformly much larger, the pinnæ up to 70 cm. long and nearly 25 cm. broad, dimensions much greater than those of the specimens just mentioned. All of these are otherwise very similar. The indusium is peculiar in having the large proximal portion deeply cleft into several elongate, lacerate divisions (these with long, tortuous, filamentous apices)

¹ See Maxon, "The tree ferns of North America," Ann. Rep. Smiths. Inst. 1911: 463-491. pl. 1-15. 1912. *Cibotium wendlandi* Mett. is another tree fern showing the same unusual adaptation.

and the smaller distal portion reduced to a few tortuous, spreading, filaments which resemble flaccid paraphyses. The divisions of the indusia appear like a lax scaly covering to fertile portions of the leaf, but sterile segments will be found nearly or quite devoid of scales.

Besides a portion of the type received from Berlin, the following specimens are in the U. S. National Herbarium:

MEXICO: Vallée de Córdoba, December 18, 1865, *Bourgeau* 1454. Córdoba, *Kerber* 36a. Atoyac, *Kerber* 122. Zacuapan, Vera Cruz, in moist shady forests, *Purpus* 3810, 4047, 6194.

GUATEMALA: San Andres Osuna, Dept. of Escuintla, *C. & E. Seler* 2548. Santa Rosa, Dept. of Santa Rosa, alt. 900 meters, *Heyde & Lux* (J. D. Smith, no. 3219). Vicinity of San Felipe, Dept. of Retalhuleu, alt. 600 meters, *J. D. Smith* 2718, 2734; *Maxon* 3532. Vicinity of San Francisco de Miramar, Costa Cuca, alt. 1,000 meters, *Pittier* 64.

EXPLANATION OF PLATE 21.—Sections of primary pinnae of, A, the type specimen (received from Berlin); B, a specimen from the dry region of Santa Rosa, Guatemala (*J. D. Smith* 3219); C, a specimen from San Felipe, Guatemala (*Maxon* 3532). All at natural size.

7. *Hemitelia escuquensis* Karst. Fl. Columb. 2: 181. 1869.

TYPE LOCALITY: Humid mountains near Escuque, western Venezuela, upon the southern shores of Maracaibo Harbor, altitude 100 meters.

DISTRIBUTION: Known also from Porto Rico.

ILLUSTRATION: Karst. op. cit. 2: pl. 196.

Hemitelia escuquensis was described and elaborately illustrated by Karsten from specimens collected by Engel in a district now included in western Venezuela. Aside from this collection the species is apparently known only from Porto Rico, two numbers (4102 and 6156) of Sintenis' specimens from that island being cited by Urban.¹ Of these only 4102 is found in the U. S. National Herbarium, this being represented by two specimens, one of which is unmistakably *Cyathea portoricensis* Spreng. and the other a partially fertile condition of a *Hemitelia* which, in the writer's opinion, is not specifically different from *H. escuquensis*. This opinion is based upon a comparison of the latter with a pinnule of Engel's original specimen, received from Berlin through the courtesy of Dr. Georg Hieronymus. Upon the authority of Doctor Hieronymus, however, the Berlin specimens of nos. 4102 and 6156 represent a single species which (both of the specimens being sterile) can not be referred definitely to the genus *Hemitelia*. They are said by him to be certainly distinct from *H. escuquensis* and it is probable that both appertain to *Cyathea portoricensis*.

The *Hemitelia* element of no. 4102 in the U. S. National Herbarium agrees closely in the more essential minute characters with the type fragment of *H. escuquensis* and with the detailed description by Karsten. It differs mainly in the lesser size of nearly all of its parts and in having the segments less strongly lobed. It has the following data:

PORTO RICO: Adjuntas, in sylvia ad Las Cruces, April 2, 1886, *Sintenis* 4102.

8. *Hemitelia multiflora* (J. E. Smith) R. Br.; Spreng. Syst. Veg. 4: 126. 1827.

Cyathea multiflora J. E. Smith, Mém. Acad. Sci. Turin 5: 416. 1793.

Amphicosmia multiflora Gardner, Lond. Journ. Bot. 1: 441. 1842.

Hemitelia nigricans Presl, Epim. Bot. 31. 1851.

Hemitelia hartii Baker, Journ. Bot. Brit. & For. 24: 243. 1886.

Alsophila decussata Christ in Pittier, Prim. Fl. Costar. 3: 41. 1901.

TYPE LOCALITY: "America meridionalis" (*R. Shakespeare*).

DISTRIBUTION: Guatemala to Panama, ascending to 1,100 meters in Costa Rica.

ILLUSTRATIONS: Bull. Torrey Club 38: pl. 35; Ann. Rep. Smiths. Inst. 1911: pl. 10. f. B. 1912.

¹ Symb. Antill. 4: 11. 1903.

The varied nomenclatorial history of this fern, known usually as *Hemitelia nigricans*, was recently discussed at length¹ by the writer, who redescribed the species, published an illustration of a part of the type material, and cited numerous specimens from Guatemala, Nicaragua, Costa Rica, and Panama, where it is apparently a not uncommon species. No recent specimens are known from Jamaica, which was long supposed to be the type locality. A further review of the material at hand leads to the conclusion that, in addition to the species previously reduced to *H. multiflora*, *Hemitelia hartii* Baker, mentioned by the writer as doubtfully distinct, must also be included in that species, a disposition which will necessitate only a slight modification of the writer's previous description.

As thus defined *H. multiflora* shows a considerable breadth of variation in venation, position of sori, and shape of segments. One extreme (the commonest form) is seen in the partially fertile state which has usually been called *H. nigricans*, in which the segments are straight or only subfalcate, the veins about equally simple and once forked, and the sori confined to the lower veins. In such specimens the few sori are distinctly supramedial or even submarginal. In fully fertile fronds (a rare condition, apparently) two variations in form are found: (1) The Costa Rican plants described as *A. decussata*, in which the pinnules are similar in shape to the partially sterile ones mentioned above, but smaller, the veins either simple or once forked, and the sori nearly medial or slightly inframedial; (2) the luxuriant, exceedingly fertile plant described by Baker (from Hart's single Chiriqui collection) as *H. hartii*, in which most of the segments are distinctly falcate and nearly all of the veins once forked and soriferous half way to the margin. In this last form the bullate scales extend sparingly to the veins, a feature noted also in the writer's specimens from Porto Bello, Panama, which otherwise are typically representative of "*H. nigricans*." The whole series shows no greater variability than *Cyathea arborea* and like that species ranges from sea level to upward of 1,000 meters. In all of the specimens the peculiar shape of the tip of the pinnæ, the alate secondary rachises, the nature and disposition of the pubescence, and the characters offered by the scales and spines of the stipe, are constant and indicate only a single variable species.

The record of specimens of *H. hartii* from Colombia doubtless relates to the original collection, Chiriqui having been a part of Colombia at that time. *Hemitelia obscura* Mett. has been referred to *H. nigricans*, that is, to *H. multiflora*; but it is amply distinct, as previously pointed out.

9. *Hemitelia muricata* (Willd.) Fée, Gen. Fil. 350. 1850-52. PLATE 22.

Cyathea muricata Willd. Sp. Pl. 5: 497. 1810.

Alsophila muricata Desv. Mém. Soc. Linn. Paris 6: 319. 1827.

Disphenia muricata Presl, Abh. Böhm. Ges. Wiss. V. 5: 349. 1848.

Caudex erect, 4 to 6 meters high, radicose toward the base; fronds 7 or 8, spreading in a wide crown, apparently 2.5 to 3.5 meters long; stipe stout, 2 to 2.5 cm. in diameter, dark castaneous, lustrous beneath a loose furfuraceous covering of minute squamules, densely armed with short straight acicular spines 1 to 3 mm. long; lamina ample, at least 140 cm. broad, deeply tripinnatifid, the rachis castaneous, lustrous, slightly muricate; pinnæ subopposite to alternate, 50 to 70 cm. long, 15 to 21 cm. broad, very abruptly acuminate, the secondary rachis similar to the primary or brownish and freely muricate, lightly furfuraceous; pinnules about 25 pairs, linear-oblong, 8 to 12 cm. long, 1.5 to 3 cm. broad, long-acuminate, distinctly petiolate (2 to 4 mm.), articulate, deciduous, approximate or contiguous, very deeply pinnatifid, the costæ densely and antrorsely strigose above, beneath stoutish, very prominent, castaneous, bearing numerous scattered subbullate brownish or light-castaneous ovate acuminate scales; segments 15 to 17 pairs, oblong to linear-oblong, 8 to 15 mm. long, 4 to 5 mm. broad,

¹ On the identity of *Cyathea multiflora*, type of the genus *Hemitelia* R. Br. Bull. Torrey Club 38: 545-550. pl. 35. 1912.

slightly falcate, acutish, lightly to deeply crenate, the proximal basal one sometimes free, the others connected by a costal wing about 1 mm. broad on each side in the basal part, wider (about 2 mm. broad) toward the apex; costules prominent, glabrous above or bearing a few minute hairs, beneath not pubescent, bearing numerous pointed bullate scales similar to those of the costæ; veins 7 to 10 pairs, oblique, mostly once (rarely twice) forked, glabrous; sori 3 to 6 pairs, large, seated at the fork of the veins, their position evident on the upper surface of the segment by sharp depressions; indusium bright brown, ample, deeply cleft into several long spreading acute segments, these fugacious; receptacle capitate, frequently bipartite with age, setose. Leaf tissue firmly membrano-herbaceous, dull dark green above, lighter below, discolored in drying.

TYPE LOCALITY: Cobstere, Martinique (*Plumier*).

DISTRIBUTION: Apparently confined to Guadeloupe and Martinique, at altitudes of from 400 to 1,100 meters.

ILLUSTRATION: *Plum. Trait. Foug. pl. 4.*

Concerning the identity of this species the writer wrote several years ago¹ as follows:

"*Cyathea muricata* Willd. Sp. Pl. 5: 497. 1810. Founded upon Plumier's plate 4 (*Traité Foug.*), representing a plant from Martinique. Baker, following Kaulfuss, has regarded Sieber's no. 374 from Martinique as agreeing with the plate; but the resemblance is slight. Sieber's plant is a large state of *Cyathea tenera*; and the plant figured by Plumier is, so far as the writer knows, yet to be rediscovered. The *C. muricata* of Grisebach is said by Christensen to be *C. furfuracea* Baker. Costa Rican specimens (*Pittier* 1839) determined by Bommer as "*Cyathea muricata* Willd. (non Kaulf.)" are *Cyathea onusta* Christ."

To these notes it should be added that possibly Sieber's no. 374, above mentioned, may have been a mixture of two or more species, since Presl² also regarded his specimen of this number as representing *C. muricata*; but that the specimen of no. 374 at the New York Botanical Garden is, nevertheless, clearly referable to *Cyathea tenera* (J. Sm.) Griseb.

More recently the National Museum has received several specimens collected by Duss in Guadeloupe and Martinique which agree very well with Plumier's plate 4, which was apparently the sole basis of *Cyathea muricata* Willd. These show the characters mentioned in the above description and serve to identify satisfactorily a species which has long been misunderstood, partly from the anomalous character of the indusium, and partly from its rarity, since it seems to be confined to these two islands of the Lesser Antilles. The specimens referred to are:

MARTINIQUE: Bois du Camp Colson, *Duss* 4602 (as *Alsophila aspera?*).

GUADELOUPE: Without locality, *Duss* 4157. Also, two specimens without number, *Duss*.

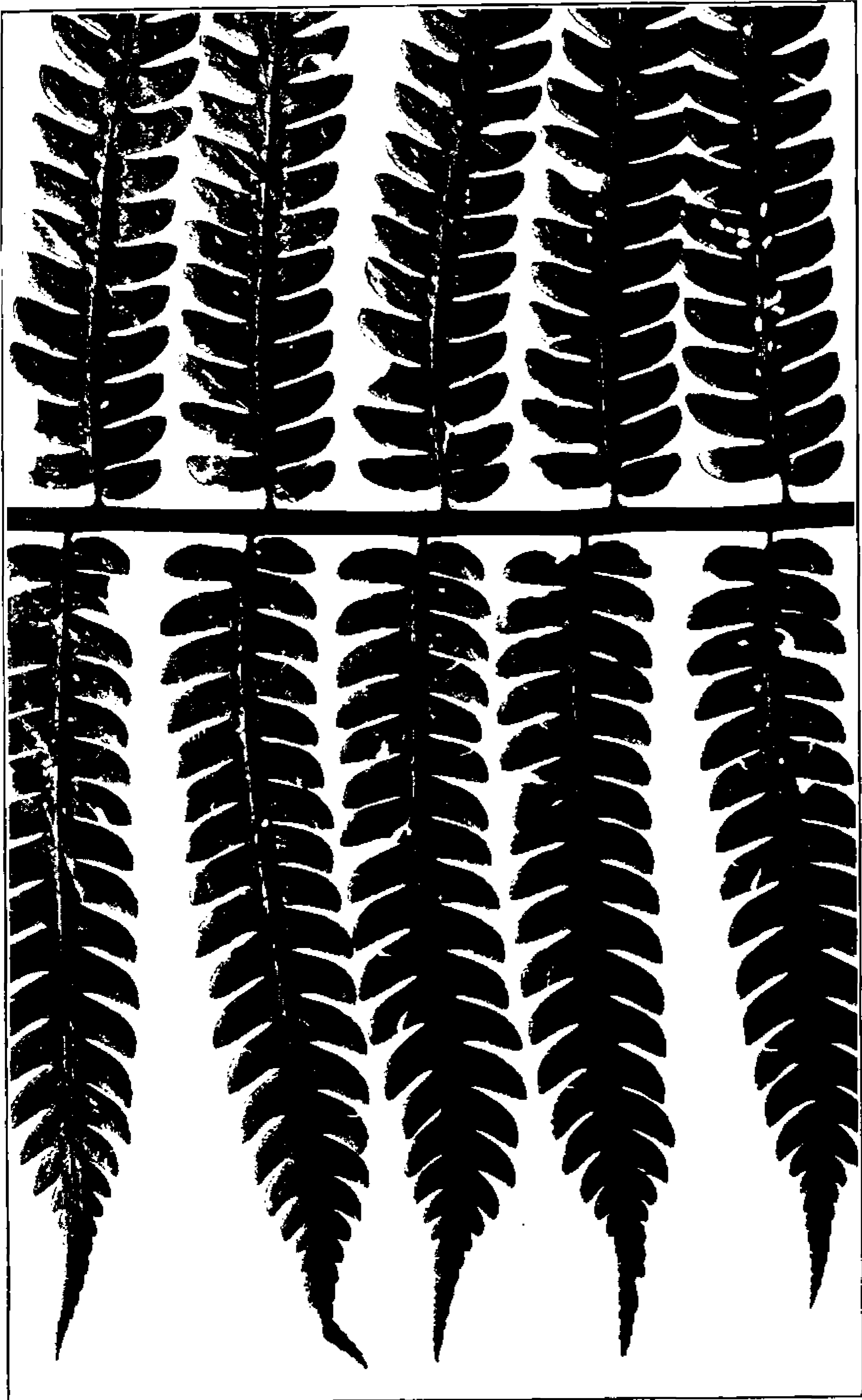
The agreement of these with Plumier's description and figure is close, particularly as to the general shape of the pinnæ and pinnules and as to the spiny stipes and rachises. The rachises are, however, much less spiny than figured—another instance of exaggeration of details by Plumier's artist. The spiny covering is nevertheless of precisely the type, though not degree, represented in plate 4.

There is at hand also another specimen from Martinique (*Duss* 4600) which is very similar in its rachises (particularly as to armature and color) and in its narrower pinnules. It probably represents a species distinct from *Hemitelia muricata*. Further material of it is much to be desired.

EXPLANATION OF PLATE 22.—Section of a primary pinna of *Hemitelia muricata* from Guadeloupe (*Duss* 4157). Natural size.

¹ N. Amer. Flora 16¹: 88. 1909.

² Abh. Böhm. Ges. Wiss. V. 5: 349. 1848.



HEMITELIA MURICATA · WILLD. · FÉE.

TWO NEW SPECIES OF MARATTIA FROM PANAMA.

In the North American Flora, volume 16,¹ but six members of the genus *Marattia* are recognized from North America. This number must be increased by the description of the following new species, both collected by the writer in the densely forested, mountainous region of western Chiriqui, Panama.

Marattia chiricana Maxon, sp. nov.

Stipe stout, about 40 cm. long; lamina very large, broadly deltoid, 1.8 meters broad, 1.3 meters long, tripinnate in all but the extreme apical portion; basal pinnæ ovate, 95 cm. long, 60 cm. broad at the middle, 40 cm. broad at the anadromous base, long-petiolate (12 cm.), nearly equilateral, comprising (below the short-acuminate, simply pinnate apex) about 8 pairs of mostly opposite, once-pinnate secondary pinnæ, the larger of these about 30 cm. long, 12 to 15 cm. broad, oblong-ovate, the tertiary rachis narrowly alate toward the tip, the segments 9 to 11 pairs, wide-spreading, 6 to 8 cm. long, 1.3 to 1.8 cm. broad, oblong-lanceolate, acuminate to long-acuminate, strongly inequilateral at the base (the distal side widely exciso-cuneate, the proximal side rounded or evenly cuneate), the margins elsewhere sharply and deeply dentate-serrate, subrevolute in drying; larger primary pinnæ 4 pairs, opposite, the second pair similar to the basal but less basispic, 70 cm. long, 45 cm. broad, the third pair 60 cm. long, 35 cm. broad, the fourth pair 40 cm. long, 25 cm. broad, all these bipinnate like the basal pair but their segments gradually smaller (2 to 2.5 cm. long, 9 or 10 mm. broad in the fourth pair) and the tertiary rachises more strongly alate; fifth pair of primary pinnæ simply pinnate, 30 cm. long, 10 cm. broad; sixth and seventh pairs successively smaller, the apex of the lamina (15 cm. long) abruptly pinnate; veins about 15 pairs, oblique, distant (arising 4 to 5 mm. apart), mostly once forked at or near the base, or the anterior branch occasionally forked again; synangia usually 12 to 20 pairs, 2 to 3 mm. from the margin, 1.5 to 3 mm. long, ovoid, laterally compressed above, deeply cleft, the two divisions wide-spreading at maturity, each containing 8 to 10 loculi. Rachises bearing a few slender deciduous flaccid brownish scales; leaf tissue rigidly herbaceous, dull green in drying, slightly lighter beneath.

Type in the U. S. National Herbarium, nos. 675926-936, consisting of an entire frond, collected in humid forest of Cuesta de Las Palmas, southern slope of Cerro de la Horqueta, Chiriqui, Panama, altitude 1,700 to 2,100 meters, March 18, 1911, by William R. Maxon (no. 5525).

In general form *M. chiricana* is apparently somewhat similar to *M. interposita*, but differs from that species widely in its much greater size, and in its very much larger, more distant, and more deeply inciso-serrate segments. The synangia also are much larger and are not submarginal, as in that species. It is apparently common in the dense, wet forests of the mountainous region of western Chiriqui above El Boquete. The following additional specimens were collected:

PANAMA: Near Los Siguas Camp, southern slope of the Cerro de la Horqueta, Chiriqui, alt. 1,700 meters, *Maxon* 5424. Forest along the upper Caldera River, near "Camp I," Holcomb's trail, above El Boquete, Chiriqui, alt. 1,450 to 1,650 meters, *Maxon* 5620.

The description is drawn entirely from the type specimen and unusually complete measurements are purposely given, since owing to piecemeal collecting these are ordinarily not available for most species of this genus.

Marattia pittieri Maxon, sp. nov.

Stipe stout, 60 cm. long; lamina broadly pentagonal-deltoid, 1.5 meters broad at the base, 1.2 meters long, quadripinnate as to the strongly basispic basal pinnæ,

¹ Pages 21-23, 1909.

otherwise tripinnate nearly throughout; primary and secondary rachises stout, terete, marginate only at their extreme apices; basal primary pinnae deltoid, 75 cm. long, 60 cm. broad at the strongly equilateral base, the inferior basal secondary pinna 40 cm. long and 25 cm. broad (the proximal portion strongly produced), the superior basal secondary pinna 20 cm. long and 9 cm. broad, the other secondary pinnae more nearly equal, essentially so near the abruptly acuminate apex, the tertiary rachises alate only toward the apices; second pair of primary pinnae less basispic, deltoid, 55 cm. long, 30 cm. broad; third and fourth pairs nearly equilateral, respectively, 30 and 40 cm. long, 23 and 17 cm. broad, the succeeding pinnae (about 3 pairs) successively shorter and finally simply pinnate below the abruptly short-acuminate apex of the lamina; larger pinnules (third order) of the basal part of the frond 10 to 17 cm. long, 2.5 to 7 cm. broad, oblong, acuminate, pinnate (the rachises widely alate), the quaternary segments mostly oval to oblong (1 to 1.5 cm. long), rounded or obtuse, lightly crenate, with 5 to 7 pairs of simple or once forked dark veins, or a few of the largest ones longer (3 to 4.5 cm. long), deeply lobed, with 7 to 10 pairs of veins, each of these with several alternate branches within the lobes. Under surfaces of the secondary and tertiary rachises bearing a few thin flaccid light brown scales; ultimate rachises and veins bearing a few whitish spine-like trichomes upon the upper surface; leaf tissue naked upon both surfaces, dark green, slightly lighter beneath.

Type in the U. S. National Herbarium, nos. 676198-203, consisting of a single frond, collected in humid forest near the upper Caldera River, at "Camp I," Holcomb's trail, above El Boquete, Chiriqui, Panama, altitude 1,625 meters, March 24, 1911, by William R. Maxon (no. 5704).

Only a single plant of this species was observed during three days' collecting in the general region of "Camp I" and this, unfortunately, had but one frond. The characters afforded by this individual, however, even in a sterile condition, are sufficiently marked to warrant its description as a new species. In the remarkable basispic development of the basal pinnae, as well as in the widely alate tertiary rachises and the peculiar spine-like trichomes of the upper leaf surface, *Marattia pittieri* shows an undoubted affinity with *M. kaulfussii*, so that there can be scarcely any question as to its proper reference to the subgenus *Eupodium*. From *M. kaulfussii* it differs greatly in its enormous size and in its much larger and differently shaped segments, which for the most part are lightly crenate, only the very largest ones in the most dissected part of the basal pinnae being lobed.

Named in honor of Mr. Henry Pittier, with whom the writer was associated in botanical exploration during the Smithsonian Biological Survey of the Panama Canal Zone and adjacent territory.

NOTES ON LYCOPODIUM.

The following notes are in continuation of earlier studies of tropical American species of *Lycopodium*, published either separately or as parts of longer papers, and relate mainly to species previously described. There are included, also, descriptions of two new species, and the publication of the new name *Lycopodium blepharodes*, applied to a South American plant described originally under an invalid name.

Lycopodium dichotomum Jacq. Enum. Stirp. Vind. 314. 1762.

The original description of this species in 1762, though brief, is sufficiently complete to fix its application to the plant so elaborately figured by the same writer a few years later.¹ The type is from Martinique, and the species is not uncommon in the West Indies and continental North America, excellent specimens being at hand from

¹Hort. Bot. Vind. 3: pl. 45. 1776.

Dominica, Grenada, Santo Domingo, Cuba, Jamaica, Mexico, Guatemala, and Costa Rica. Not infrequently plants produce sporangia while still very small (10 cm. long, or less) and only once or twice dichotomous. This state was described as a new species, *Lycopodium barbatum* Christ,¹ in 1905, upon a Costa Rican specimen collected by Wercklé, a portion of which Prince Roland Bonaparte has courteously presented to the U. S. National Museum. Matching it completely are certain specimens from Costa Rica (*Ridgway*), Nicaragua (*Flint; Wright*), and Brazil (*Lindman A2705*); while a second Brazilian specimen (*Malme 1664*) shows a less juvenile condition approaching the normal form of the species. This species is unusually variable in the direction of its leaves, the less mature plants not being typical in this respect.

Lycopodium wilsonii Underw. & Lloyd, Bull. Torrey Club 33: 109. 1906.

In the original description of *L. wilsonii* only the type specimens (*Wilson 153*) were mentioned. There are in the U. S. National Herbarium two additional collections of this species, both from the type region, the Sierra Luquillo.

Porto Rico: Sierra de Luquillo, in sylvis montis Yunque, July 13, 1885, *Sintenis 1543* (distributed as *L. dichotomum*). El Yunque, March, 1912, *Hioram 383*.

Lycopodium blepharodes Maxon, nom. nov.

Lycopodium affine Hook. & Grev. Bot. Misc. Hook. 2: 364. 1831, not Bory, 1804.

TYPE LOCALITY: Mount Pichincha, Ecuador (*Jameson*).

DISTRIBUTION: Mountains of Ecuador and Venezuela, ascending to 3,300 meters.

This species, of which several collections from Ecuador and Venezuela are mentioned by Hooker and Greville and by Spring, can not retain the name *affine* on account of the earlier use of this name by Bory for a very unlike species (from Bourbon) which is an ally of *L. carolinianum*. The South American plant is accordingly here renamed *blepharodes*, in allusion to the numerous curved cilia which fringe both sporophylls and leaves. Two sheets of Ecuador specimens, both collected by Jameson, one of them labeled Cerro de Pichincha, are in the National Herbarium, and a third, also from the Quitensian Andes, collected by Jameson, is in the Gray Herbarium. These agree well with the descriptions by Hooker and Greville and Spring.² The habit of the specimens points unmistakably to an epiphytic habitat.

The Costa Rican specimens erroneously referred to this species by Hieronymus are to be regarded as a new species, *L. hoffmanni*.

Lycopodium hoffmanni Maxon, sp. nov.

Plants apparently terrestrial, rigidly arcuate-ascending or erect, 25 to 40 cm. long, once or twice (rarely 3 times) dichotomous, the divisions erect, diverging at a very acute angle, continuously or discontinuously sporangiate in the apical half or two-thirds. Stems 2 to 3 mm. in diameter, woody; leaves and sporophylls alike, borne apparently in 10 ranks, ascending or mostly spreading and recurved, wholly or partially concealing the stem, radial, straight or nearly so, not twisted at the base, lanceolate to narrowly deltoid-lanceolate, 5 to 7 mm. long, 1 to 1.5 mm. broad at or just above the base, gradually narrower toward the acute (but not attenuate) apex, thick, rigidly spongiose-herbaceous, dull yellowish green, the inner surface slightly concave and sometimes transversely corrugate, the outer surface often longitudinally striate in drying, the costa percurrent, evident as a slight dorsal ridge, a little stronger at the base and decurrent, the stem thus angled, but not sharply so; margins of the leaves and sporophylls strongly hyaline, distantly denticulate-serrulate, the teeth mostly low and rounded or those of the sporophylls a little more evident, sharper and closer; sporangia crowded, orbicular-reniform, 1.5 to 2 mm. broad, extending far beyond the sides of the sporophylls.

¹ Bull. Herb. Boiss. II. 5: 254. 1905.

² Mém. Acad. Sci. Brux. 15^o: 21. 1842; *ibid.* 24¹: 6. 1850.

Type in the U. S. National Herbarium, no. 691549, collected upon the Volcán de Barba, Costa Rica, August 28, 1855, by Dr. C. Hoffmann (no. 85).

Hieronymus¹ has listed this number under *Lycopodium affine* Hook. & Grev., here renamed *L. blepharodes* Maxon, remarking that it differs slightly in its shorter-denticulate leaves. The differences, however, are pronounced and clearly entitle this Costa Rican plant to recognition as a distinct species. It departs widely from *L. blepharodes* in habit, in having the leaves and sporophylls smaller, less deltoid, less concave, and not at all strongly carinate, and particularly in the character of the margins. The leaves and sporophylls of *L. blepharodes* are conspicuously long-ciliate throughout, while no cilia whatever occur in *L. hoffmanni*. The difference in habit is equally pronounced, *L. blepharodes* being unmistakably a pendent epiphyte and *L. hoffmanni* a plant of erect growth, presumably terrestrial. The general habit of *L. hoffmanni* is exactly that of the common tropical American *L. reflexum* Lam., a species which otherwise it does not closely resemble. That species occurs invariably upon the ground, either in half-shaded thickets or upon open banks or even on cliffs; while *L. hoffmanni* has the appearance of a plant growing among litter of the forest floor, like *L. montanum* Underw. & Lloyd, of Jamaica, and *L. hippurideum* Christ, of Costa Rica and western Panama.

A single additional specimen of *L. hoffmanni* has been seen:

COSTA RICA: Forest of Volcán de Barba, alt. 2,500 meters, February 6, 1890.
Tonduz 1990 (determined by Christ as *L. attenuatum* Spring).

***Lycopodium regnellii* Maxon, sp. nov.**

PLATE 23.

Plant probably terrestrial, stout, rigidly erect from a decumbent base, 4 or 5 times dichotomous, the numerous apical branches closely fasciculate and almost continuously sporangiate. Stem woody, about 4 mm. in diameter at the base; leaves in the basal half of the plant mostly divaricate or even reflexed in drying, arranged in 10 to 12 ranks, crowded and nearly concealing the stem, radial, straight or nearly so, lance-subulate, 7 to 10 mm. long, 1.3 to 1.6 mm. broad at the base, thence gradually and evenly long-acuminate, pungent, rigidly coriaceous-herbaceous but relatively thin, flattish, strongly costate throughout (the leaf narrowly carinate ventrally, more obtusely so upon the upper surface), the margins hyaline, subentire or very minutely sinuate; ultimate branches fertile, 4 to 5 mm. in diameter (including sporophylls), the sporophylls similar to the leaves of the lower branches but smaller (3 to 5 mm. long) and more abruptly and sharply long-acuminate; sporangia orbicular-reniform, 1 to 1.4 mm. broad.

Type in the U. S. National Herbarium, no. 201172, collected in the vicinity of Caldas, province of Minas Geraës, Brazil, October 21, 1868, by A. F. Regnell (III.1500).

Lycopodium regnellii is a member of the *selago* subgroup and is apparently well distinguished from related South America species by the contrasting direction of the leaves and sporophylls, the former being strongly divaricate from the stems, the latter imbricate and closely appressed. Only the type specimen has been seen.

EXPLANATION OF PLATE 23.—From a photograph of the type specimen. Slightly more than one-half natural size.

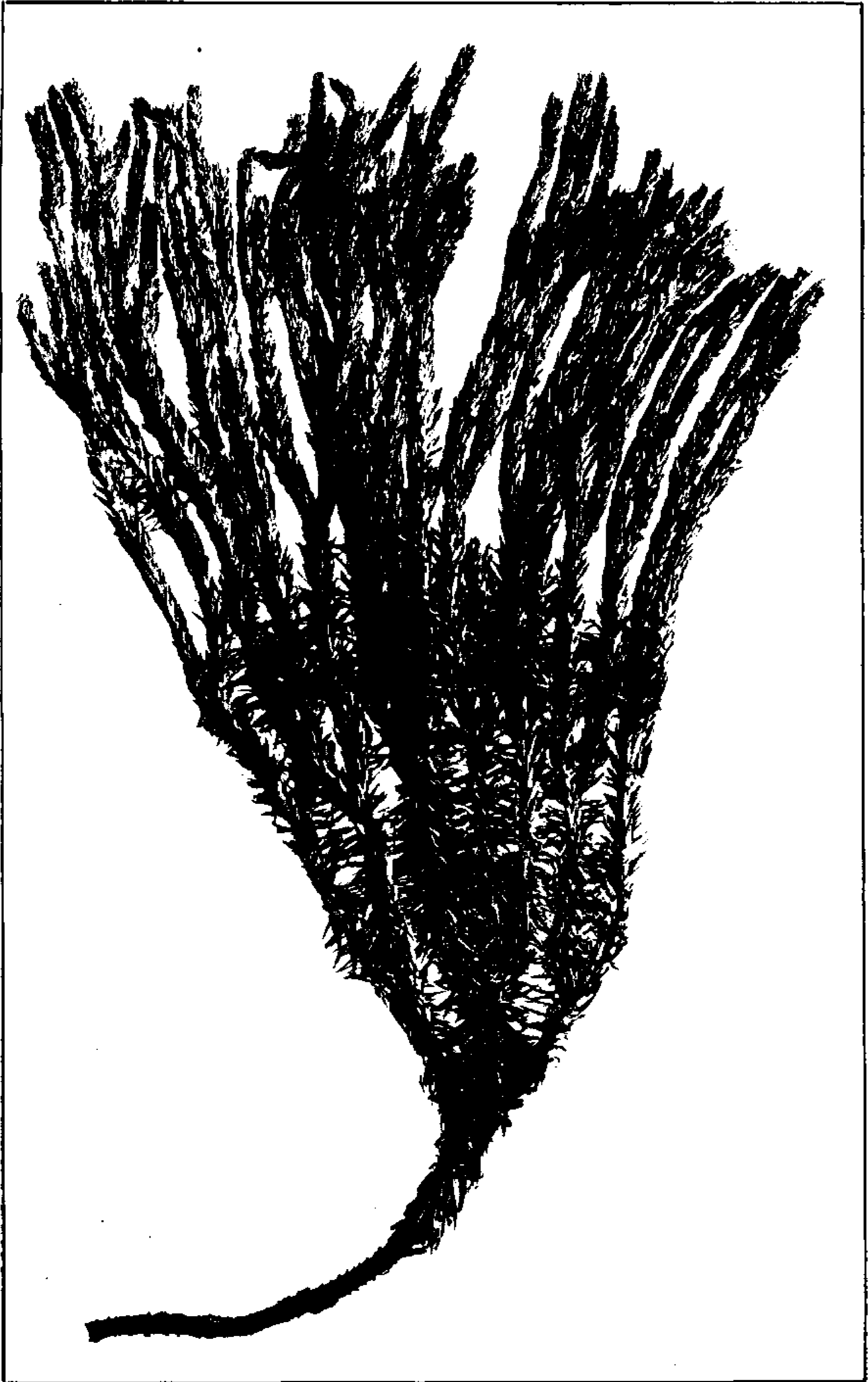
***Lycopodium hippurideum* Christ in Pittier, Prim. Fl. Costar. 3¹: 56. 1901.**

This species, known previously only from the high mountains of Costa Rica (Pittier 10619; Tonduz 1989) was collected in quantity by the writer, in 1911, at the edge of moist woods above El Potrero Camp, Chiriquí Volcano, Panama, altitude 2,900 meters (Maxon 5375).

***Lycopodium pithyoides* Schlecht. & Cham. Linnaea 5: 623. 1830.**

Since the publication of Underwood and Lloyd's article upon the tropical American species of *Lycopodium*² this species has been collected at Jalapa, Mexico, the type

¹ Bot. Jahrb. Engler 34: 571. 1905. ² Bull. Torrey Club 33: 101-124. 1906.



LYCOPodium REGNELLII MAXON.

locality, by Messrs. Barnes, Chamberlain, and Land, and reported on by them.¹ A part of this material has been presented to the U. S. National Museum. An additional collection also may be cited:

GUATEMALA: Near Coban, Alta Verapaz, alt. 1,300 meters, on tree trunks, August, 1885, *von Türckheim* (J. D. Smith, no. 551); distributed as *L. dichotomum* Jacq., "form (*L. mandioccanum*, Raddi)."

Lycopodium watsonianum Maxon, *Smiths. Misc. Coll.* 56²⁹: 3. pl. 3. 1912.

Lycopodium watsonianum, described from a single specimen collected by the writer in humid forest along the upper Caldera River, Chiriqui, Panama (*Maxon* 5712), may now be reported from Costa Rica, upon the basis of a specimen collected near the Rancho Flores, altitude 2,043 meters, by A. Tonduz (no. 2081).

Lycopodium cuneifolium Hieron. *Bot. Jahrb. Engler* 34: 572. 1905.

Besides the original Costa Rican specimens (*Hoffmann* 59) and the Colombian plant (*Moritz* 371) cited by Hieronymus the following may be mentioned:

COSTA RICA: Laguna de Reventado, Volcano Irazú, alt. 2,800 meters, *Pittier* 14136. Forests of Achiote, Volcano Poas, alt. 2,200 meters, *Tonduz* 10740.

PANAMA: Below summit of Cerro de la Horqueta, Chiriqui, alt. about 2,150 meters, *Maxon* 5475.

Lycopodium subulatum Desv. in *Lam. Encycl. Bot. Suppl.* 3: 544. 1813.

Lycopodium biforme Hook. *Icon. Pl.* 3: 228. 1840.

This species, which is undoubtedly a variable one, is not reported from North America by Underwood and Lloyd. Identifying it on the basis of Hooker's plate, the following specimens in the National Herbarium may be cited:

COSTA RICA: Forests of Volcan de Barba, alt. 2,500 to 2,700 meters, *Tonduz* 1958.

PANAMA: Humid forest near Cerro de la Horqueta, Chiriqui, alt. 2,200 meters, *Maxon* 5482.

¹ *Bot. Gaz.* 44: 57-63. pl. 5, 6. 1907.