

STUDIES OF TROPICAL AMERICAN FERNS—NO. 4.

BY WILLIAM R. MAXON.

INTRODUCTION.

The present paper, like the preceding ones of this series,¹ includes brief discussions of several genera or smaller groups of species which have been the subject of great confusion, but which it is now possible to treat with some degree of assurance. Similar conditions prevailing in very many, if not in most, genera of tropical American ferns lead to the conclusion that effort in this field should at present be directed more to the systematizing of work already done than to the description of new forms. The preservation of most of the older type specimens in European herbaria affords to European students a distinct advantage which is, perhaps, not fully realized. At any rate very little monographic or even synoptical work upon the part of European fern students has recently found its way into print, a noteworthy exception being the conscientious and elaborate work of Christensen in the difficult genus *Dryopteris*.

Indeed, the method of treatment adopted by Christensen, involving a critical review of actual type specimens, supplemented by a study of the vast aggregate of additional material which it is now possible to bring together from the larger herbaria, may well serve as a model. Studies like this are urgently required in *Adiantum*, *Pteris*, *Blechnum*, certain groups of *Asplenium* and *Athyrium*, *Hypolepis*, *Dennstedtia*, *Lindsaya*, and *Polystichum*—to mention a few of the more conspicuous examples. Many of the species of these genera are without doubt correctly understood by fern students generally; but it is equally true that a large proportion of the less well known species have been repeatedly published as new, partly from ignorance or disregard of results obtained by others, and partly from failure to interpret successfully the faulty diagnoses of others, especially the early writers. The necessity of studying and restudying the constantly increasing number of scattered descriptions imposes a heavy burden

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.

upon the student who is desirous of avoiding the publication of "new" species which will ultimately be relegated to synonymy. Relief will be found only in the manner mentioned—by the publication of synopses of the genera, with full synonymy.

The much larger task of preparing an authoritative treatment of the Pteridophyta as a whole would at the present time be beset with difficulties of many sorts; in part those inherent in any full treatment of so large and difficult a group, in part others of the kind encountered in many groups of lower cryptogams especially, in which there has been not only a lack of stability in the generic concept, but also no general agreement upon a method of selecting the generic type. Many of the genera present other and grave difficulties which need not here be enumerated. In the endeavor to order the species by genera according to their affinities it will often be necessary to disregard differences of venation and the presence, absence, or modification of special structures like the indusia, which, though formerly regarded as all-important, are now frequently found to be characteristic of species only or of minor groups of species, and on the other hand to lay greater stress upon habitual characters, these, though less tangible, serving to indicate far more accurately the probable lines of descent. The recognition of genera upon this basis will necessitate a wide comparison of specimens from regions now isolated, and will, unfortunately, afford fewer absolute superficial criteria to the maker of the generic keys. But this inconvenience carries small weight against the more natural arrangement which will certainly result, involving also a possible reduction in the number of genera.

Inability or lack of opportunity to deal with the subject in a large way should not, in any case, serve to delay critical studies of the smaller groups, whose limits and principal characters can be clearly indicated. Studies of the latter sort may often be carried to completion merely as phases of the larger work and will prove useful not only in themselves but also in their bearing upon the study of related groups of Pteridophyta. Considering the great amount of exploration carried on in the past it is only natural that so much attention should have been given purely to the description of new species; but this pioneer work having in great measure been accomplished, it may reasonably be expected that, with the benefit of modern systematic methods now generally employed, a more serious attempt will be made in the immediate future to definitely systematize the knowledge which we now have.

ASPLENIUM TRICHOMANES AND ITS AMERICAN ALLIES.

The writer's especial interest in the group of *Asplenium trichomanes* dates from 1900, when he described *Asplenium vespertinum* from specimens collected in San Diego County, California. This well-

marked species had been strangely confused with a nearly or quite sterile, incised, leafy form of true *A. trichomanes* which occurs in Europe and has been found once or twice in the eastern United States. *Asplenium vespertinum* is, however, but one of a group of rather closely related species, well represented in the American tropics and mostly marked by excellent characters, whose relationship and limitations are not well understood. In view of this fact it has seemed desirable to bring together the following notes, and to publish a key by means of which the several species may be identified. To this end the writer has examined critically the specimens in most of the larger American herbaria and has had also the benefit of specimens and data obtained in field work over a large part of the area covered. As must often be the case, the number of species to be recognized has decreased materially as specimens and data have accumulated.

Asplenium heterochroum and *A. castaneum* will serve as excellent examples. The former species is known chiefly from Bermuda and Florida specimens which latterly have been called *A. muticum*; and only upon the very recent collection of adequate Cuban material has it been found that Kunze's *A. heterochroum*, described from imperfect Cuban specimens and nearly lost sight of since its publication in 1834, really represents the same species in slightly different form, the name *heterochroum* therefore applying to the whole. In the case of *A. castaneum* there has been not only a recent redescription under the name *A. rubinum*, but also a very general failure to note the unusually wide extremes of leaf form within the species, the difference amounting almost to the development of two types of fertile fronds, as explained later.

Considering the proneness of ferns to extreme variation, it must be apparent that, in the case of many old as well as new or little known species, the advantage to be gained from studying a large series of specimens is very great, since only in this way will it be possible to determine the extent not only of unusual variation, but even of the normal fluctuation which is inherent in nearly every species. Besides variations of the latter type, relatively and actually very great in ferns, unusual attention must be given to transitional states which may commonly be correlated with geographical distribution. With large series at hand extreme variants are not so likely to be described as new species. For the sake of determining distribution and relationship, also, unusually extensive collecting is necessary in so variable a group. In no other way will it be possible to know tropical ferns so thoroughly as we know those of temperate regions, the latter from our constant observation of them in the field and herbarium being more or less familiar in all their phases. We often forget that tropical ferns offer a similar or even greater range of variation, and that the chance collecting of a few specimens

from scattering localities in all probability affords a wholly insufficient basis for determining the mean of the species. A suitable series of specimens has been available in the present study, and the number of species here recognized is probably not far from correct.

As delimited below, the group of *Asplenium trichomanes* is a natural and fairly compact one, though there are numerous species which connect it with several related groups of simply pinnate species. Among these may be mentioned that of *Asplenium viride*, including such small species as *A. fragile*, *A. quitense*, and *A. flabellifolium*, characterized by green or greenish stipes; that of *A. erectum*, with a multitude of species, mostly with larger fronds, the stipes dull brownish to greenish or grayish green; that of *A. normale*, containing species with polished dark brown or blackish stipes and differing from the *trichomanes* group by their larger and relatively broader fronds. These in turn pass into bipinnate and tripinnate forms so gradually and in such infinite variety that a natural arrangement of the species of the genus as a whole is exceedingly difficult. However, keeping in mind the principal characters of *A. trichomanes* as representative, little difficulty need be experienced in associating the various members of this group, which may be characterized briefly as follows:

ASPLENIUM TRICHOMANES GROUP.

Small ferns, mostly 10 to 30 cm. high, the once-pinnate fronds nearly linear, tufted upon an erect or ascending, usually short rhizome, the stipes and rachises firm, subterete to trigonous, bright brown or castaneous to black or purplish black, minutely to broadly alate, sometimes sparingly fibrillose-scaly; pinnæ mostly small, equilateral to strongly asymmetrical; venation pinnate to flabellate-dichotomous.

The American species may be separated by means of the following artificial key:

KEY TO THE SPECIES.

- Fronds mostly rooting at the tip of the flagelliform apex..... 10. *A. palmeri*.
 Fronds not rooting at the apex, this not flagelliform.
 Indusia conspicuously ciliate or laciniate.
 Veins forked; indusia delicately ciliate; rachis scantily pubescent..... 5. *A. blepharodes*.
 Veins simple; indusia deeply laciniate; rachis distinctly fibrillose..... 4. *A. fibrillosum*.
 Indusia entire to crenulate or somewhat erose.
 Fronds apparently pendent; pinnæ distant..... 11. *A. extensum*.
 Fronds erect, ascending, or rotate; pinnæ closer.
 Sterile and fertile fronds difform, the sterile ones prostrate or nearly so..... 15. *A. platyneuron*.
 Sterile and fertile fronds similar, not arranged in two series.
 Sori borne mostly upon the inferior (proximal) side of the pinnæ.
 Pinnæ deeply cleft upon the upper margin; fronds very numerous, the stipes and rachises slender, blackish..... 13. *A. formosum*.

- Pinnæ denticulate to crenate-serrate upon the upper margin; fronds less numerous, the stipes usually stouter, castaneous.
- Scales of the rhizome brownish to blackish, often iridescent..... 17. *A. monanthes*.
- Scales of the rhizome light ferruginous 16. *A. denudatum*.
- Sori borne mainly in pairs, i. e. those of the distal and proximal sides nearly equal in number.
- Fertile veins (some or all, exclusive of the basal ones) forked.
- Lamina 5 to 9 cm. broad; pinnæ relatively few.
- Pinnæ 10 to 20 pairs, all but the basal ones narrowly oblong from an acute or subrectangular inequilateral base, obtuse..... 18. *A. melanorachis*.
- Pinnæ 7 or 8 pairs, much larger, distant, strongly deltoid from a broadly cuneate inequilateral base, acute 19. *A. kellermanii*.
- Lamina 1 to 3 (rarely 4) cm. broad; pinnæ numerous.
- Pinnæ deeply crenate-serrate or incised; rhizome scales yellowish brown, with a heavy dark median stripe..... 14. *A. carolinum*.
- Pinnæ subentire to crenate; rhizome scales dark brown or blackish.
- Sori short, borne near the margin; scales with long capillary apices..... 9. *A. resiliens*.
- Sori relatively longer, nearer the midvein than the margin; scales merely long-attenuate.
- Stipes and rachises conspicuously alate, more or less fibrillose; fronds few; pinnæ subrectangular-oblong; veins of the proximal side simple..... 8. *A. nesioticum*.
- Stipes and rachises faintly alate, not fibrillose; fronds very numerous; pinnæ oval to oval-oblong; veins of both sides usually forked..... 1. *A. trichomanes*.
- Fertile veins (the distal basal ones excepted) usually simple.
- Scales of the rhizome light ferruginous..... 16. *A. denudatum*.
- Scales of the rhizome brown to blackish.
- Sori confined to the lobes of the pinnæ..... 3. *A. pringlei*.
- Sori not borne upon the lobes.
- Stipes and rachises black or blackish.
- Pinnæ broadly crenate; stipes and rachises very slender, minutely alate..... 2. *A. underwoodii*.
- Pinnæ sharply crenate-dentate; stipes and rachises stouter, conspicuously alate.... 6. *A. heterochroum*.
- Stipes and rachises castaneous or distinctly brown.
- Rhizomes short; fronds closely fasciculate, ascending or rosulate, strongly arcuate..... 7. *A. vespertinum*.

Rhizomes large, woody, elongate (2 to 10 cm. long); fronds densely imbricate, erect.

Indusia entire, usually narrow and elongate..... 17. *A. monanthes*.

Indusia noticeably erose, more ample, short and relatively very broad..... 12. *A. castaneum*.

1. *Asplenium trichomanes* L. Sp. Pl. 1080. 1753.

Phyllitis rotundifolia Moench, Meth. Pl. 724. 1794.

Asplenium saxatile Salisb. Prodr. Stirp. 403. 1796.

Asplenium melanocaulon Willd. Enum. Pl. 1072. 1809.

Asplenium microphyllum Tineo in Gussone, Fl. Sic. Syn. 2¹: 884. 1844.

TYPE LOCALITY: Europe.

DISTRIBUTION: Generally distributed in Europe, and in North America from Alaska and the region of Hudson's Bay southward to Alabama, Texas, and Arizona.

ILLUSTRATIONS: Schkuhr, Krypt. Gewächs. 1: pl. 74; D. C. Eaton, Ferns N. Amer. 1: pl. 36. f. 1-3; Moore, Brit. Ferns Nat. Pr. 2: pl. 75; Williamson, Ferns Kentucky pl. 16; Bolton, Fil. Brit. pl. 13; Hook. Fl. Lond. pl. 156; Sowerby, Ferns Great Brit. pl. 30.

Asplenium trichomanes, as represented by the common plant of Europe and North America, is too well known to require redescription or full citation of its very numerous illustrations, and it is doubtful whether in its typical form it occupies a much wider area. Certainly the writer has seen no material from other regions which is unmistakably the same. Thus, *Asplenium anceps* von Buch,¹ illustrated by Hooker and Greville,² appears to be a distinct species, though not so regarded by Milde.³ Although it has been attributed to Great Britain it is apparently confined to the Azores and Canary Islands. *Asplenium newmani* Bolle,⁴ founded upon specimens from Palma, of the Canaries, is a related species recognized by both Milde and Christensen.

Of the Asiatic specimens of this alliance there are more distinct specific forms than have as yet been recognized. That which approaches North American specimens most closely is found in Japan, but it differs materially in several important particulars and probably represents a valid species about equally related to *Asplenium trichomanes* and *A. anceps*. Out of the Chinese material the writer has segregated *A. microtum*,⁵ and Copeland has published also *A. stantoni*,⁶ from Luzon, both of which, as well as *A. densum* Brack.,⁷ a native of the Hawaiian Islands, seem to be well founded. These, together with additional material from Central China, South Africa, and New Zealand, will be considered separately at a later time, since their status does not affect materially that of the species here discussed.

2. *Asplenium underwoodii* Maxon, sp. nov.

FIGURE 1.

Rhizome ascending, slender, 4 to 5 mm. in diameter, at the summit densely paleaceous, the scales rigid, linear-lanceolate, attenuate, opaque, dark brown, about 3 mm. long; fronds few (4 to 10), radiating, somewhat arcuate toward the base, 12 to 21 cm. long (averaging about 16 cm.); stipe 2.5 to 6.5 cm. long (averaging about 3.5 cm.), very slender and fragile, deep purplish black, somewhat lustrous, both stipe and rachis very narrowly alate, the wings subentire; lamina linear, 9 to 14.5 cm. long,

¹ Besch. Canar. Ins. 189. 1825.

² Icon. Fil. 2: pl. 195. 1830.

³ Fil. Eur. Atlant. 62. 1867.

⁴ Bonplandia 7: 106. 1859.

⁵ Contr. U. S. Nat. Herb. 12: 411. pl. 60. 1909.

⁶ Philippine Journ. Sci. Suppl. 1: 151. 1906.

⁷ In Wilkes, U. S. Expl. Exped. 16: 151. pl. 20. f. 3. 1854.

10 to 14 mm. broad; pinnæ 20 to 25 pairs, sessile, approximate or sometimes nearly their width apart, opposite or subopposite, characteristic middle ones oblong, 5 to 6.5 mm. long, 3.5 to 4 mm. broad, at the base broadly cuneate, the margins elsewhere regularly and broadly crenate, the apex obtusely rounded; lower pinnæ shorter, 2.5 to 3.5 mm. long, 3.5 to 4 mm. broad, horizontal; sori oblong, averaging 3 pairs to each pinna, nearly medial upon the spreading simple veins; indusia membranous, whitish, glabrous, the margin somewhat sinuate or slightly erose; spores ovoid, more or less alate, densely muricate-cristate.

Type in the U. S. National Herbarium, no. 427538, collected from chinks of a cliff in humid forest on the upper slopes of John Crow Peak in the Blue Mountains of Jamaica, altitude between 1,650 and 1,800 meters, April 18, 1903, by William R. Maxon (no. 1319), in company with Prof. L. M. Underwood, whose specimens are in the Underwood Fern Herbarium of the New York Botanical Garden.

One of the rarest and most delicate of the Jamaican species, somewhat resembling *A. trichomanes*, with which it was confused by Jenman, but differing in several essential characters, notably in its few and exceedingly delicate fronds, in its very slender and dark-colored vascular parts, and in its fewer sori and simple veins. It has been collected at the type locality also by Harris, whose specimens (nos. 7338, 7902 in part) are in the Underwood Fern Herbarium, and by Hart.

3. *Asplenium pringlei* Davenp. Gard. & For. 4: 449. 1891.

TYPE LOCALITY: Wet cliffs near Guadalajara, State of Jalisco, Mexico, December 5, 1888 (*Pringle* 1837).

DISTRIBUTION: Known only from the States of Jalisco and Chihuahua, Mexico.

ILLUSTRATION: Loc. cit. 4: f. 71.

The present species, which seems to have been gathered only by Mr. Pringle, is by far the most strikingly peculiar one of the group. In describing it Mr. Davenport compared it with the "incised form of *Asplenium trichomanes*," meaning particularly no doubt the species since described as *A. vespertinum*. But it has no close relationship with that species, the deeply lobed pinnæ and the unique submarginal position of the sori setting it apart from that as from all other members of the group. The lobes of the pinnæ are rounded, yet appear more or less acute and distant in the dried specimen, owing to the usual inflection of the margins. The sori are short, tumid, and very conspicuous, being placed wholly within the deep lobes and near to the margin.

The following specimens have been examined: ¹

MEXICO: Wet cliffs and mossy ledges near Guadalajara, State of Jalisco, *Pringle*, 1837 (N, Y); *Pringle* 2769 (M, P); *Pringle* 4089 (herb. B. D. Gilbert). Sierra Madre, Chihuahua, October 21, 1887, *Pringle*, without number (P).

4. *Asplenium fibrillosum* Pringle & Davenp. Bot. Gaz. 21: 257. 1896.

TYPE LOCALITY: Mossy banks, canyons above Cuernavaca, State of Morelos, Mexico, altitude 1,650 meters, November 21, 1895 (*Pringle* 6191).

DISTRIBUTION: Known only from the States of Mexico and Morelos, Mexico.

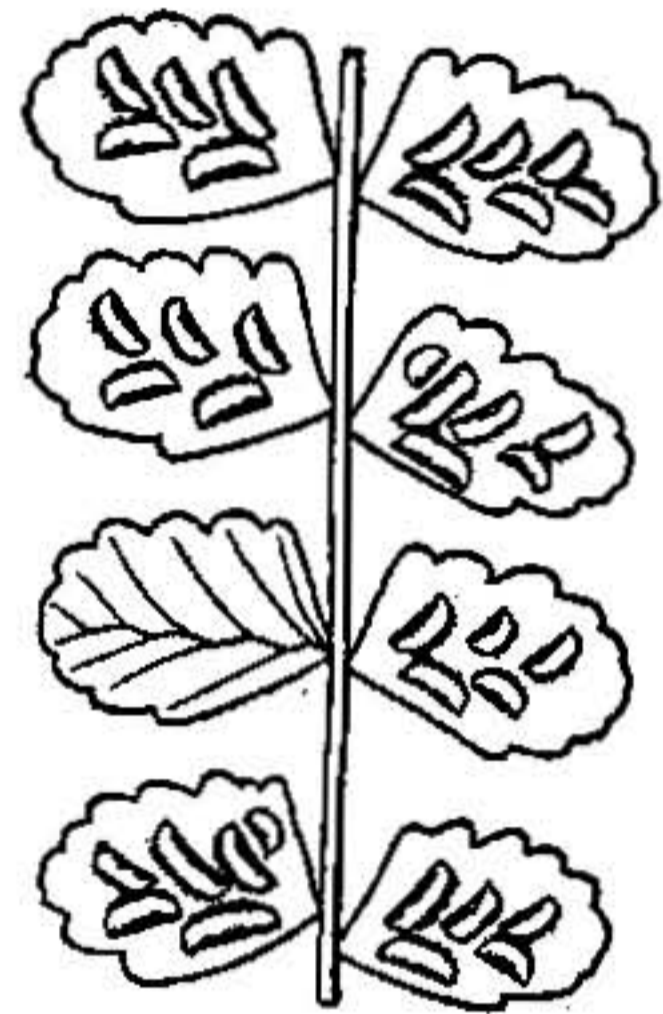


FIG. 1.—*Asplenium underwoodii*. Part of type specimen. Scale 2.

¹ The herbaria from which specimens are cited are indicated by the following letters: E, D. C. Eaton Herbarium, Yale University; G, Gray Herbarium; M, Herbarium of the Missouri Botanical Garden; N, Herbarium of the U. S. National Museum (U. S. National Herbarium); P, Pringle Herbarium, University of Vermont; Y, Underwood Fern Herbarium, New York Botanical Garden.

ILLUSTRATION: *Op. cit.* 21: *pl.* 18. *f.* 1-4.

There is little to be added to Mr. Davenport's careful diagnosis, except that some specimens (e. g., *Rose & Painter* 7857) attain a greater width (1.8 cm.), and that the texture may be called truly coriaceous. The veins though obscure are simple, as opposed to the once-forked veins of its nearest ally, *A. blepharodes*, a species which Mr. Davenport appears to have overlooked. The fibrillose character appears to be a constant one. The indusia are deeply lacinate, and the long, jointed, flaccid, white cilia sometimes attain a length greater than the width of the indusium proper. Large specimens have 4 or 5 pairs of sori to each pinna, with an occasional extra one upon the auricle.

The following specimens have been examined:

MEXICO: Mossy banks, canyons above Cuernavaca, State of Morelos, alt. 1,650 meters, November 21, 1895, *Pringle* 6191 (N, Y, M). Sheltered ledges and grottos in the lava fields near Eslaba, Federal District, September, 1903, *Pringle* 8791 (N, P). Mossy banks near Cuernavaca, State of Morelos, alt. 1,500 meters, November 13, 1902, *Pringle* 11257 (N). Near Tultenango, State of Mexico, October 13, 1903, *Ross & Painter* 7857 (N).

5. *Asplenium blepharodes* D. C. Eaton, *Zoe* 1: 197. 1890.

TYPE LOCALITY: Sierra de la Laguna, Lower California (*Brandegge*).

DISTRIBUTION: Lower California.

ILLUSTRATION: *Loc. cit.* 1: *pl.* 7.

Confined apparently to Lower California, and collected there thus far only within a restricted region; to be compared only with *A. fibrillosum*. In the specimens studied the vascular parts are not fibrillose; the sori are longer and make a more acute angle with the midvein than in *A. fibrillosum*; and the indusia are more regularly and delicately ciliate, the cilia shorter. The most unmistakable point of difference lies in the forked veins, those of *A. fibrillosum*, as noted under that species, being simple. The fronds, moreover, are chartaceo-membranaceous (instead of coriaceous) and the margins are bicrenate-serrate.

The following specimens have been examined:

MEXICO: Sierra de la Laguna, Lower California, January 23, 1890, *Brandegge* 660 (N); *Brandegge*, without number, January 24, 1890 (N). Laguna, Lower California, *L. Belding* 17 (G).

6. *Asplenium heterochroum* Kunze, *Linnaea* 9: 67. 1834.

FIGURE 2.

Asplenium muticum Gilbert, *Amer. Bot.* 4: 86. 1903.

TYPE LOCALITY: Mossy shaded rocks, Embarcadero del Caminar, Cuba (*Poeppig*).

DISTRIBUTION: Mountains of eastern Cuba, ascending to 500 meters; also in peninsular Florida and Bermuda.

This species was described as new several years ago under the name *Asplenium muticum* by Gilbert, who studied only Bermuda and Florida material, his type specimen being from Bermuda. More recently Cuban specimens have been collected which clearly represent *Asplenium heterochroum* Kunze, and a comparison of these with the plants of Bermuda and Florida shows all to be of the same species, notwithstanding certain minor variation in size and form. The Bermuda specimens are the best developed of all, a few individuals attaining a height of nearly 50 cm. The plants from Florida and Cuba are rarely more than 20 cm. high. *Poeppig's* original specimens, as evidenced by a diminutive example in the herbarium of the Missouri Botanical Garden, were even smaller (less than 10 cm. high), but are otherwise like recent Cuban material.

Asplenium heterochroum is related to *A. nesioticum* of the Blue Mountains of Jamaica, from which it differs mainly in its sharply crenate-dentate margins and membranous texture, the veins usually being readily apparent by transmitted light. From *A. resiliens*, with which it was long confused in Florida, it differs conspicuously in its

chaff, which, though attenuate, is never hair-pointed, in the shape and position of its sori (these longer and much nearer the midvein), in its thin rather than decidedly coriaceous texture, and usually in the character of its margins. The reduced lower pinnæ also are broadly cuneate and more or less flabelliform, never auriculate-cordate as in *A. resiliens*.

The following specimens have been examined:

CUBA: Ad rupes umbrosas muscosas, ad Embarcadero del Caminar, *Poeppig* (M). Near Nouvelle Sophie, on vertical rocks and ledges, sides of the Farallones, October 8, 1859, *Wright* 1042 (E). Sierra Cubitas, Camaguey, east pass, at mouth of cave, *Shafer* 446 (N). "Posesion de Starck," southeast of Jaguey, Yateras, Oriente, alt. about 500 meters, in crevices of partially shaded precipice, *Maxon* 4433 (N). Finca Las Gracias, Yateras, Oriente, alt. 500 meters, in clefts of small rock ledges in forest, *Maxon* 4497 (N).

BERMUDA: Limestone sinks or shaded ledges, several localities, *Goode* (M, N); *Kemp* (Y); *Maxon* (G, M); *Farlow* (G); *Gilbert* (G, Y, N, Gilbert); *Howe* (Y); *Harshberger* (N); *S. Brown & Britton* 29 (N).

FLORIDA: Shaded rocks, Appalachicola River, near Aspalaga, *Curtis* 3720* (Y, N, P, E, M)¹. Rocky woods near Istachatta, *Curtiss* 5966 (Y, N, M, P). Limestone rocks around sink holes, Ocala, *Gilbert* (N); *Underwood* 132 (N). Columbia County, *Hitchcock* (M). Indian River, *Miss Reynolds* in 1878 (M). Sumter and Marion counties, in 1879, with *A. resiliens* intermixed, *J. D. Smith* (N).

7. *Asplenium vespertinum* Maxon, Bull.

Torrey Club 27: 200. 1900. FIGURE 3.

TYPE LOCALITY: San Miguel Mountain, near National City, San Diego County, California (*Laura F. Kimball*).

DISTRIBUTION: Southern California and Lower California.

Except for the single locality in Lower California, *Asplenium vespertinum* is known only from the mountains of southern California. It has a certain relationship to *A. blepharodes*, but is easily distinguished by its differently shaped crenations, shorter and more numerous sori, and nonciliate indusia.

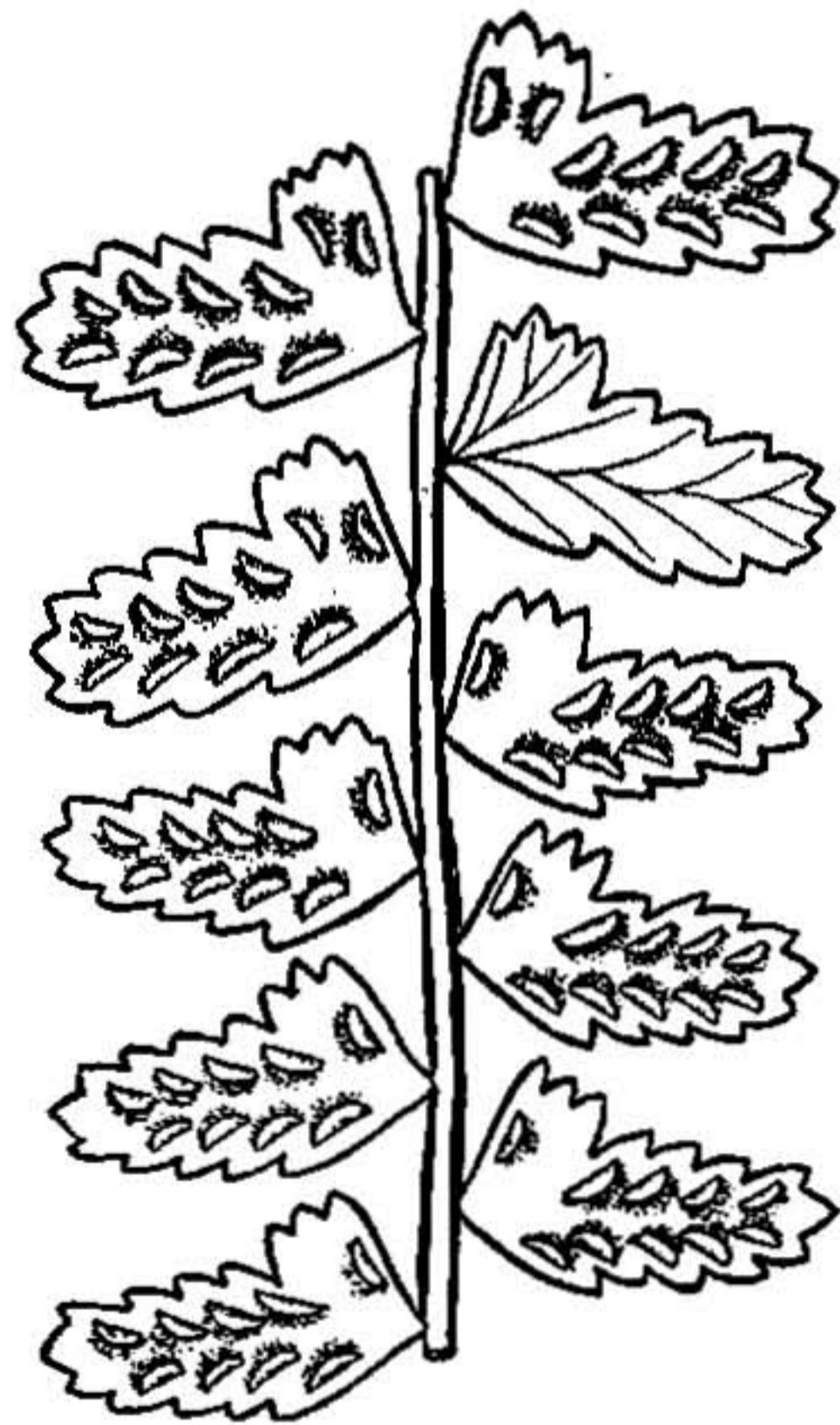


FIG. 2.—*Asplenium heterochroum*. Collected in Bermuda by Gilbert. Scale 2.

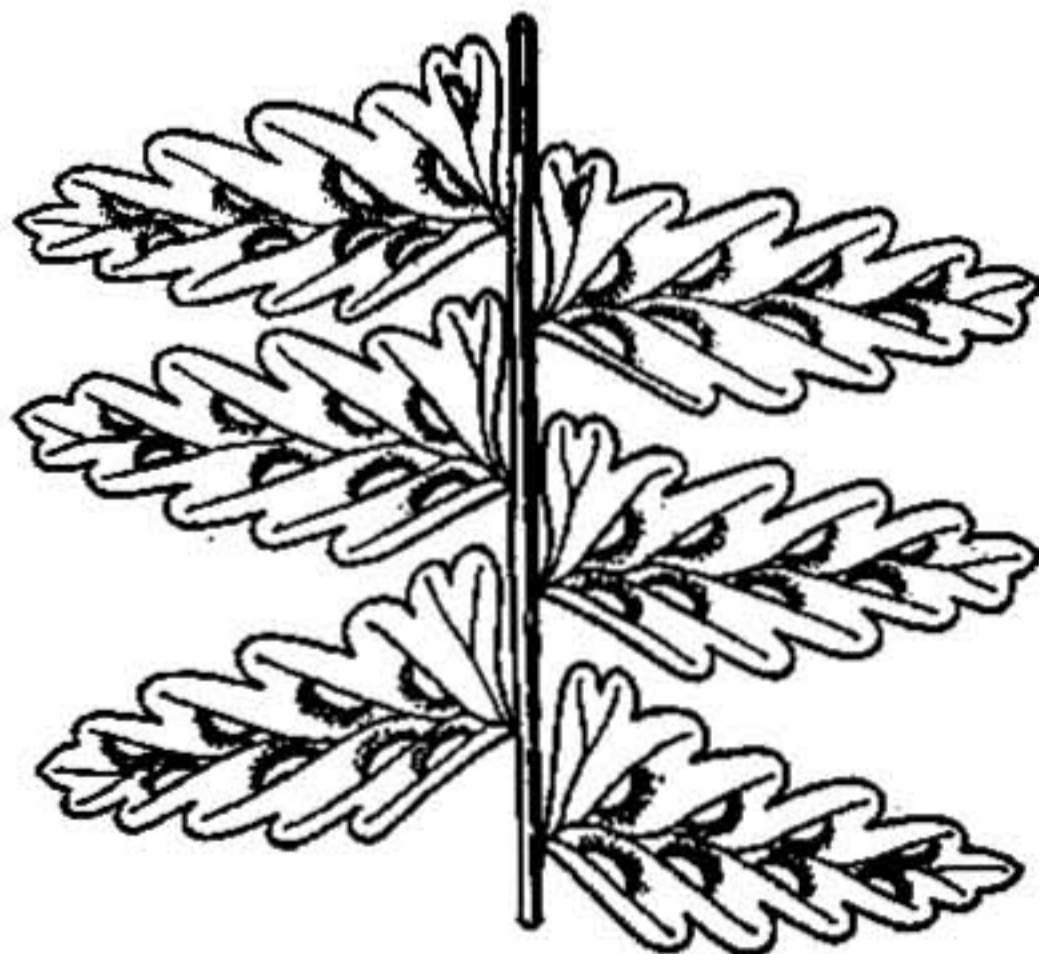


FIG. 3.—*Asplenium vespertinum*. Part of type collection. Scale 2.

¹ In several herbaria this number is partly *A. resiliens*.

The following specimens have been examined:

CALIFORNIA: San Diego, *Cleveland* (N); *Miss Barbeck* (E); *Lemmon* (M). San Diego County, *Stout* (Y). San Miguel Mountain, near National City, San Diego County, *Miss Kimball* (N). Moreno Canyon, San Diego County, *Stout* (Y). Near Poway, San Diego County, *Stout* (P, E). Vicinity of Santa Ysabel, *Henshaw* (N). Tufts under rocks, Cajon Valley, near San Diego, *Newberry* (E).¹ San Gabriel Mountains, near Pasadena, *McClatchie* (N). San Bernardino, *Spellman* (Y). Without locality, *Parry* (E). Witch Creek, San Diego County, *R. D. Alderson* (herb. A. A. Eaton).

MEXICO: Near San Rafael, Lower California, April 13, 1882, *M. E. Jones* 3749 (N). [San Rafael?,] Lower California, April 13, 1882, *Pringle*, without number (P).

8. *Asplenium nesioticum* Maxon, sp. nov.

FIGURE 4.

An erect plant, with 6 to 9 linear rigid dark green fronds, 12 to 19 cm. long. Rhizome short, decumbent or erect, 6 to 8 mm. in diameter, the upper part clothed with numerous narrowly lanceolate attenuate dark brown scales 3 to 3.5 mm. long; stipe 2 to 4 cm. long, very dark purplish brown, sublucid, conspicuously alate (the wing

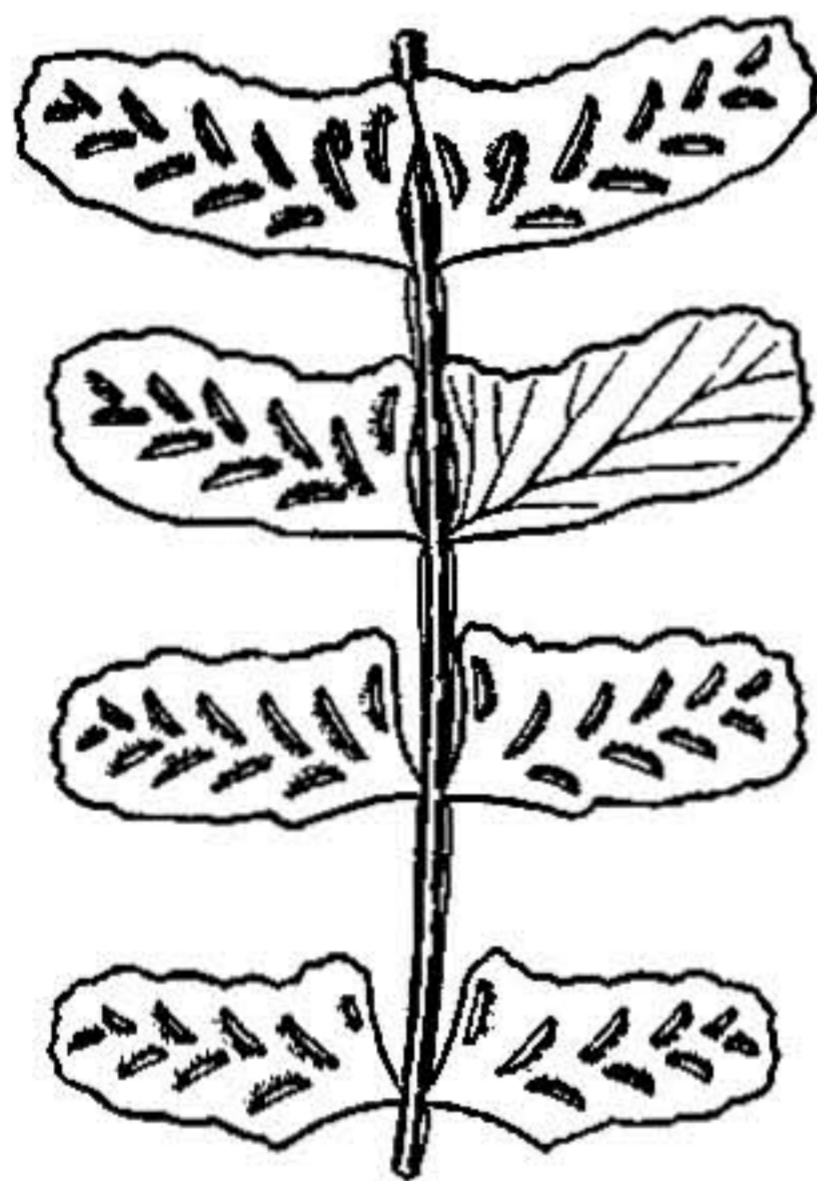


FIG. 4.—*Asplenium nesioticum*. Part of type specimen. Scale 2.

yellowish brown, entire) and sparingly fibrillose with dark deciduous scales similar to those of the rhizome but reduced and finally filiform; lamina 10 to 16 cm. long, 1.5 to 2 cm. broad, tapering in both directions (but more gradually below), the apex short-elongate, deeply crenate or lobate; pinnæ 18 to 25 pairs, sessile, coriaceous, opaque, nearly glabrous, with a few scattered whitish hairs below; characteristic middle pinnæ 8 to 12 mm. long, 3 to 5 mm. broad, horizontal, oblong, slightly curved, attached at the base of the inner margin, the base above subrectangular-auriculate, the margins elsewhere sinuate, obscurely or sometimes regularly crenate, the crenations most pronounced at the rounded apex, the lower margin usually sinuate only; lower pinnæ gradually much reduced, somewhat reflexed, distant, subtriangular or the lowermost suborbicular to flabelliform, their base broadly cuneate, medial in attachment; rachis similar to the stipe, more widely

alate, a few filiform scales borne at the base of the pinnæ; veins pinnate, the basal superior one 2 or 3-forked, the others simple or once-forked, the lower veins simple; sori elongate, linear, slightly curved, originating close to the midvein and always borne

¹ This locality was originally published by the writer as follows: "Tufts under rocks, Cajon Pass (San Bernardino County,) near San Diego Mission, Nov. 9, 1857, Dr. Newberry." The following note, received from Mr. S. B. Parish under date of August 17, 1901, not only calls attention to a probable error but also gives interesting data as to the distribution of the species:

"Permit me to call your attention to a confusion of localities in a citation under your character of *Asplenium vespertinum*, viz., 'Cajon Pass (San Bernardino County,) near San Diego Mission.' Cajon Pass, in this [San Bernardino] county, is 100 miles from San Diego; but there is a Cajon Valley about 20 miles from San Diego, and in that county, which is probably the place intended. Your species belongs to the Coast flora and is not rare on the seaward side of the Coast mountains. At Pasadena it reaches as you note, the San Bernardino range, as do many other of the Coast plants. One or two straggling specimens have been got near San Bernardino."

There can be little doubt that Cajon Valley is the correct locality. The old San Diego Mission referred to stood near the present city of San Diego.

nearer to the midvein than to the margin, the next to the lowermost of the upper row occasionally subdiplazioid; indusia linear, firm, whitish, persistent, irregularly erose; spores light brown, somewhat translucent, conspicuously alate, the ridges sharp and anastomosing coarsely.

Type in the U. S. National Herbarium, no. 427745, collected from ledges above Green River, on the trail from Cinchona to Blue Mountain Peak, Jamaica, at an estimated elevation of 1,050 meters, April 22, 1903, by William R. Maxon (no. 1487).

Asplenium nesioticum is apparently confined to Jamaica. It was well characterized by Jenman¹ under the name "*Asplenium ebeneum* Ait." and properly distinguished from its two Jamaica allies, *A. underwoodii* and *A. resiliens*, the "*trichomanes*" and "*parvulum*" respectively of Jenman's treatment. In its mature development it has usually the upright habit, rigid fronds, oblong middle pinnæ, and reflexed lower pinnæ of *A. resiliens*; but it differs from this species conspicuously in its orbicular or flabelliform, noncordate lower pinnæ, its very much longer sori, these placed near the midvein (whereas in *A. resiliens* they are short and near the margin), and by its chaff, this having the apices attenuate but by no means capillary as in *A. resiliens*. Jenman's grounds for associating this plant with Aiton's *A. ebeneum* (*A. platyneuron*) and citing Eaton's plate 4, must remain a matter for speculation, for the two species have no very close relationship. From *A. underwoodii* it differs in nearly all general as well as minute characters. The species is known only from Jamaica.

Besides the type the following specimens have been examined:

JAMAICA: Crevices of wet cliffs, near Green River, on the trail from Cinchona to Blue Mountain Peak, *Maxon* 1493 (N); *Underwood* 2557 (Y), 2561 (Y). Upper slopes of John Crow Peak, in chinks of cliffs in wet woods, *Maxon* 1344 (N); *Underwood* 708 (Y). Old England (below Cinchona), *J. Hart* (N); *Underwood* 1662 (Y). Near Cinchona, alt. 1,500 meters, *Underwood* 2587 (Y). Pleasant Hill, *Harris* 7905 (Y, N). Pleasant Hill Lower Works, August, 1898, *Harris* 7316² (N).

9. *Asplenium resiliens* Kunze, *Linnaea* 18: 331. 1844.

Asplenium parvulum Mart. & Gal. *Mém. Acad. Sci. Brux.* 15^b: 60. 1842, not Hook. 1840.

TYPE LOCALITY: Near Capulalpan and Hacienda del Carmen, eastern Oaxaca, Mexico, altitude 1,800 to 2,100 meters (*Galeotti* 6462).

DISTRIBUTION: Virginia to Kansas, south to Florida, the Gulf States, Arizona, and in the mountains sparingly through Mexico to Guatemala; also in Jamaica.

ILLUSTRATIONS: *Mém. Acad. Sci. Brux.* 15^b: pl. 15. f. 3; D. C. Eaton, *Ferns, N. Amer.* 1: pl. 36. f. 5, 6; Waters, *Ferns* 143 (text figure).

Specimens of the type collection of this species have not been seen by the writer. Agreeing very well, however, with the original description by Martens and Galeotti, and with the sketch figure published by them, are certain Mexican specimens which may safely be taken as representing this species; for example, Dr. Edward Palmer's no. 446, collected in 1902, from narrow chinks of shaded cliffs at Alvarez, San Luis Potosí, altitude about 2,400 meters. These specimens are exceedingly fertile and the fronds are narrow and stiffly erect, with auriculate and mainly retrorse segments. A large proportion of the United States specimens are less rigid and a little more leafy; but others from the Southwestern States and the Mexican boundary region are practically identical with the Mexican.

¹ Bull. Bot. Dept. Jamaica 46: 8. 1893.

² By an unfortunate interchange of labels plants of this collection in the Jenman Herbarium at the N. Y. Botanical Garden bear Mr. Harris's number 7325 and the locality as New Haven Gap, Jamaica. Mr. Harris writes that these are data actually pertaining to *Histiopteris incisa*, as collected by him.

In the original description the margins of the pinnæ are mentioned as entire, which is by no means invariably true. In a majority of specimens they are nearly entire, and the leaf tissue is so coriaceous that, unless rather strongly cut, the slightly revolute margins commonly appear to be entire or subentire. But in other specimens they are crenulate, or even deeply crenate in unusually luxuriant plants which may have grown in deep shade or under exceptional conditions. The veins, excepting the lowermost superior one (which is several times forked), are mostly once-forked, the sorus commonly being borne altogether upon the anterior branch. The sori are thus, on account of their origin, short and as a rule situated nearer to the margin than to the midvein. With age they are readily confluent, forming a broad marginal band around the pinnæ, or even completely covering the under surface.

The name *Asplenium resiliens*, which is the one under which this species must be known, was given by Kunze solely to replace the untenable name *A. parvulum* Mart. & Gal. (1842), which is invalidated by *A. parvulum* Hook. (1840). This fact, which was pointed out by the writer in 1902¹ and recognized by Mr. Gilbert in his discussion of *A. muticum*,² was yet disregarded by him in his later notes upon that species,³ when he suggested that "*parvulum*" and "*resiliens*" may represent two different forms or even species. As a matter of fact, *A. resiliens* is, within well established limits, a variable species, but hardly more so than a majority of those ferns which occupy equally extensive ranges. In this case the points of difference are not correlated with geographic distribution, as Mr. Gilbert erroneously surmised from his meager material.

This species has been well described repeatedly of late. Besides the difference in marginal form there is considerable variation in the shape of the pinnæ. Those of the middle part of the frond are commonly oblong and auriculate only at the upper side of the base; but occasionally (for example, in Arkansas specimens collected by Mr. James H. Ferriss) they are strongly auriculate both above and below, a form which is usual in the shorter dwindling lower pinnæ of most specimens. The largest individuals seen are plants collected near Blount Springs, Alabama, by John Donnell Smith, in 1884, measuring 35 cm. in height. The species is a common one in the southern United States and apparently prefers limestone.

The specimens examined, omitting those from the United States, are as follows:

MEXICO: Soledad, 25 miles southwest of Monclova, Coahuila, *Palmer* 1435 in 1880 (N, E, M). Monte Albán, near Oaxaca City, Oaxaca, alt. 1,650 to 1,800 meters, *C. L. Smith* 2036, as *A. trichomanes* (M, N). Orizaba, *J. G. Smith* (M, N). Chinks of shaded cliffs Alvarez, San Luis Potosí, alt. 2,400 meters, *Palmer* 446 in 1902 (N). Rocky banks near Tierra Blanca, Chiapas, *Collins & Doyle* 129 (N). Chiapas, *Ghiesbreght* (E). Sierra Madre, near Monterey, Nuevo León, June 8, 1888, *Pringle* (P).

GUATEMALA: San Miguel Uspantán, Dept. Quiché, alt. 1,800 meters, *Heyde & Lux* (*J. D. Smith* 3261) (N).

JAMAICA: Without locality, *Hart* 59 (N). Near Cinchona, alt. 1,500 meters, *Harris* 7899 (Y), 7903 (Y); *Clute* 99 (N). Portland Gap, *Bot. Dept. Coll.* 7904 (Y). Abbey Green, *Bot. Dept. Coll.* 7900 (Y); *Maxon* 1396 (N); *Maxon* 1408 (N). John Crow Peak, alt. 1,800 meters, *Harris* 9702 (Y); *Hart* (N). Several localities, *Underwood* 925, 926, 927, 1194, 2521 (all in Y).

10. *Asplenium palmeri* Maxon, *Contr. U. S. Nat. Herb.* 13: 39. 1909.

TYPE LOCALITY: Shaded mountain near Etzatlan, State of Jalisco, Mexico, October 2, 1903 (*Rose & Painter* 7582).

¹ Fern Bull. 10: 46. 1902.

² Amer. Bot. 4: 86. May, 1903.

³ Fern Bull. 11: 77-79. July, 1903.

DISTRIBUTION: Widely distributed in Mexico; also in Petén and Alta Verapaz, Guatemala.

Asplenium palmeri is unique among the species of this group in the prolonged naked apices of its fronds, the ends proliferous, rooting, and often bearing young plants. The specimens examined have previously been cited.

11. *Asplenium extensum* Fée, Mém. Foug. 7:51. 1857.

TYPE LOCALITY: Ocaña, Colombia (*Schlim* 629).

DISTRIBUTION: Colombia and Peru.

ILLUSTRATION: Fée, loc. cit. *pl. 13. f. 2*, representing the type specimen.

Although no specimens of *Asplenium extensum* have been seen by the writer, it is possible to here include this species because of its marked peculiarities, as shown by Fée's very complete figures. It has been reported from Peru recently by Hieronymus,¹ though it appears to have been unknown to Sodiro² as occurring in Ecuador. Mettenius has redescribed³ it upon the basis of Fée's illustration.

12. *Asplenium castaneum* Schlecht. & Cham. Linnaea 5: 611. 1830.

FIGURES 5, 6, 7.

Asplenium rubinum Davenp. Bot. Gaz. 19: 391. 1894.

Asplenium trichomanes var. *castanea* Hieron. Bot. Jahrb. Engler 34: 459. 1905.

TYPE LOCALITY: Mount Orizaba, Mexico (*Schiede & Deppe*).

DISTRIBUTION: High mountains and volcanoes of Mexico and western Guatemala to Peru and Bolivia, ascending to 4,500 meters.

The failure of Hooker and several later writers upon ferns to recognize *Asplenium castaneum* as a species amply distinct from *A. trichomanes* may be attributed partly to a want of complete material and in greater part to the prevalence of a different conception of species limits; but that this confusion should have persisted till now is rather remarkable. Thus, *Asplenium trichomanes* is mentioned by a recent American writer⁴ as one of several species of the northeastern United States which extend far southward, this species in particular being found "above 3,350 meters" upon the Volcan de Fuego, Guatemala. *Asplenium trichomanes*, however, barely reaches northern Mexico, and the Guatemalan plant in question is *A. castaneum*. Recently also Hieronymus,⁵ notwithstanding his exact and highly painstaking work upon the Pteridophyta in general, has regarded *A. castaneum* as a variety of *A. trichomanes*; although its greater size and more sturdy habit, as well as the delicate, large, brown scales of the rhizome, the very stout, fibrillose stipes, the large pinnæ, and the very large and broad, erose indusia should suffice to differentiate it at once as a distinct species.

Mr. Davenport, who was loth to describe new species, holding always to a very broad concept of specific limits, had no doubt of the distinctness of this plant, though he seems not to have known of the application of the name *castaneum*. In describing this species as *A. rubinum* he compares it with *A. trichomanes*, remarking that "once seen it is not likely to be mistaken for any other known species." The type of *rubinum* is Mr. Pringle's no. 5191, from the Sierra de las Cruces, State of Mexico. This and Mr. Pringle's no. 6150, collected later at the same locality, are perfectly characteristic of *A. castaneum*, and include plants of two different sorts: (1) Specimens which are stout and exceedingly fertile, the pinnæ nearly medial in attachment and having usually 4 or 5 pairs of crowded sori to each; and (2) others which are only partially fertile, having the pinnæ trapeziform-oblong in outline, mostly attached at the proximal point of

¹ Hedwigia 47: 223. 1908.

² Sodiro, Crypt. Vasc. Quit. 143. 1893.

³ Abh. Senckenb. Ges. Frankfurt 3: 182. 1860.

⁴ Rhodora 10: 20. 1908.

⁵ Bot. Jahrb. Engler 34: 459. 1905.

the inner margin and bearing only 3 or 4 sori each. The first is shown in figure 5; the second in figure 6. In minute characters the two plants are identical, and a similarly pronounced variation in leaf form, venation, and fertility is observed in specimens from other localities, notably in a series collected by the writer at the summit of the Volcano Agua. The thin, flaccid, transparent, reticulate, dull-brownish scales, which are both conspicuous and numerous, are characteristic (see fig. 7). From the exceedingly fertile, high-mountain form of *A. monanthos*, which is sometimes known as *A. polyphyllum* Bertol. (shown in pl. 1, figs. *h, i, k*), *A. castaneum* may be distinguished readily by its relatively broader and differently shaped pinnæ, by its shorter and broader, decidedly erose indusia, and by the different character of the rhizome scales. It has been fully described by Mettenius¹ and it is not likely to be confused with any other American species.

The following specimens of *A. castaneum* have been examined:

MEXICO: Subalpine region of Mount Orizaba, among rocks, March, 1908, *Purpus* (N). Same locality, *Rose & Hay* 5746 (N). Same locality, alt. about 4,270 meters, *Seaton* 245 (N, G). Same locality, alt. about 3,300 meters, *Seaton* 163 in small part (N). Same locality, alt. 4,500 meters, *Jared G. Smith* 90 (N). Mount Popocatepetl, alt. about 3,600 meters, *Rose & Hay* 5988 (N). Mount Ixtaccihuatl, among rocks, alt. 3,050 to 3,350 meters, *Purpus* 226 (N). Volcano of Colima, Jalisco, *Jones* 526 (N). Sierra de las Cruces, State of Mexico, alt. 3,650 meters, *Pringle* 5191 (P, G). Same locality, *Pringle* 6150 (G, M, N, Y, P, Gilbert). Nevada de Toluca, State of Mexico, alt. 3,080 to 3,230 meters, *Rose & Painter* 7943 (N).

GUATEMALA: Volcan de Agua, crevices of cliffs near the summit, alt. 3,750 meters, *J. D. Smith* 2446 (N); *J. D. Smith* 2449 (G, N, Y); *Maxon & Hay* 3696 (N). Same locality, in crevices of rocks, lower rim of crater, *Maxon & Hay* 3697 (N). Volcano Atitlan, Dept. Sololá, *Kellerman* 5795 in part (N). Top of Volcan de Fuego, *Salvin & Godman* 225 (G).

PANAMA: Rocks near El Potrero Camp, Chiriqui Volcano, alt. 2,890 meters, *Maxon* 5326 (N). Near summit of Chiriqui Volcano, alt. about 3,300 meters, *Maxon* 5367 (N).

PERU: Obragilla, *Wilkes Expedition* (N).

ECUADOR: Without locality, *Sodirol* (N, Y).

BOLIVIA: Unduavi, alt. about 3,050 meters, *Rusby* 407, as *A. extensum* (N, Y).

13. *Asplenium formosum* Willd. Sp. Pl. 5: 329. 1810.

? *Asplenium nanum* Willd. Sp. Pl. 5: 323. 1810.

Asplenium subalatum Hook. & Arn. Bot. Beechey Voy. 312. 1840.

Asplenium formosum β *subalatum* Moore, Ind. Fil. 133. 1859.

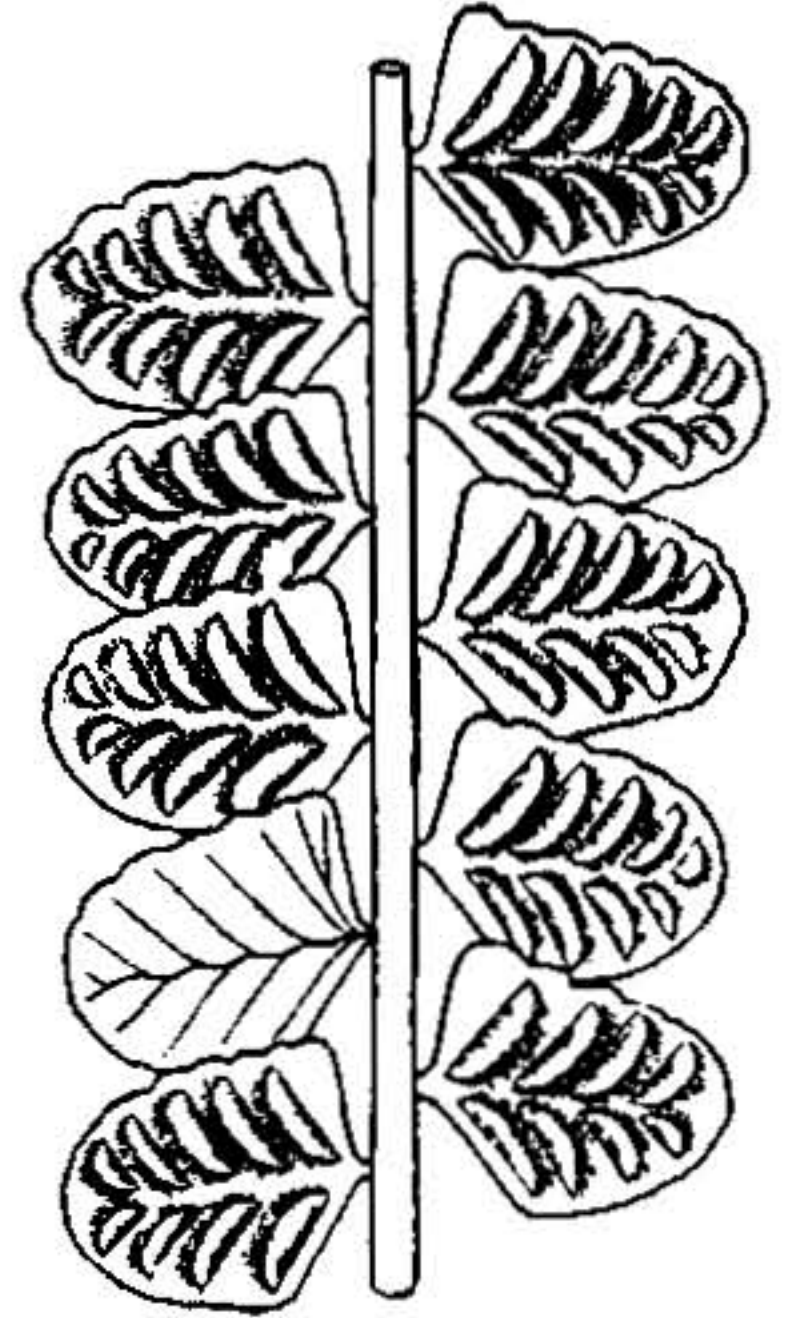


FIG. 5.—*Asplenium castaneum*.
Pringle's 6150. Scale 2.

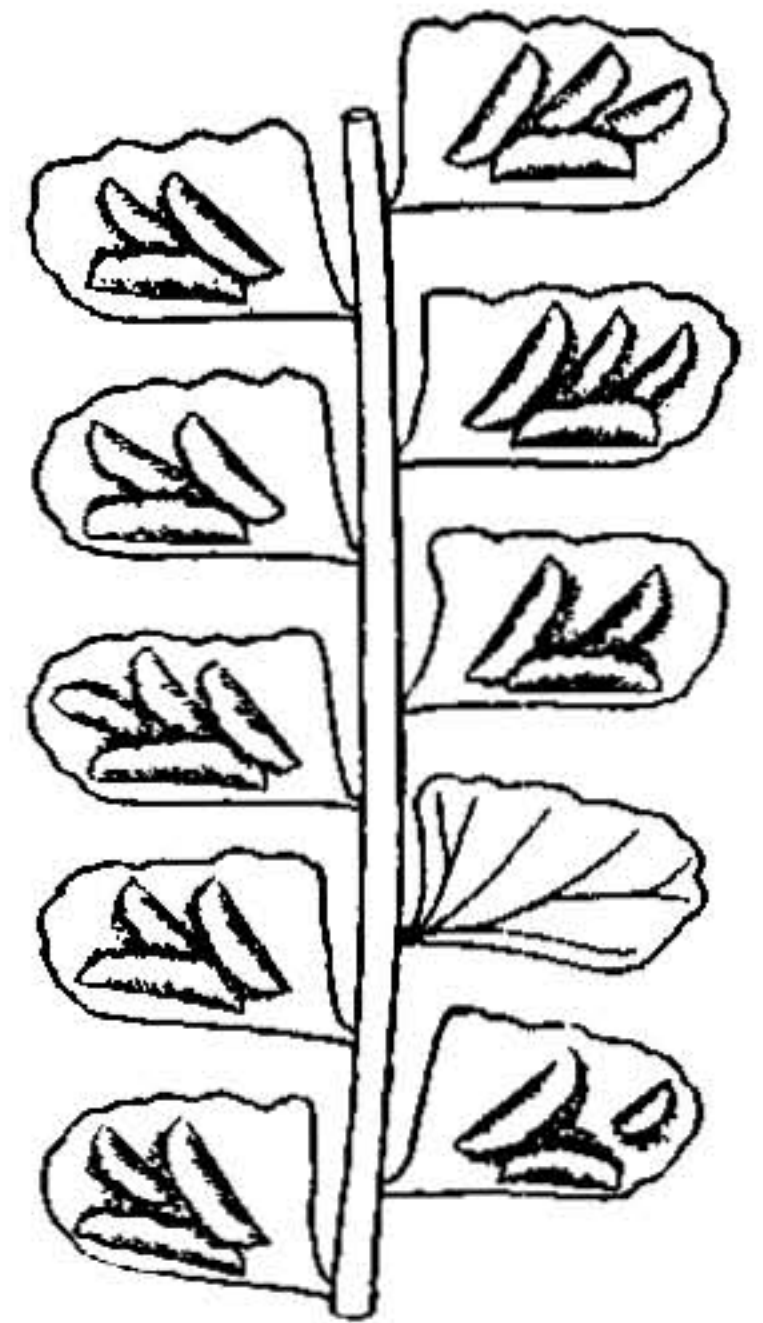


FIG. 6.—*Asplenium castaneum*.
Pringle's 6150. Scale 2.

¹ Abh. Senckenb. Ges. Frankfurt 3: 181. 1860.

TYPE LOCALITY: Shady woods near Caracas, Venezuela (*Bredemeyer*).

DISTRIBUTION: General in tropical America, being widely dispersed in the West Indies and extending on the continent from Mexico to Bolivia and Brazil. It occurs also in southern India, Ceylon, and tropical Africa.

ILLUSTRATIONS: Hook. & Arn. loc. cit. pl. 71 (as *A. subalatum*); ? Plum. Trait. Foug. pl. 66. f. B.; Hook. Exot. Ferns pl. 16.

This, which is the commonest species of the *trichomanes* group in tropical America, is well known and shows comparatively little variation. It is remarkable for the almost uniform position of its few sori upon the proximal side of the pinnæ and for the lacinate character of the upper margins. Plate 16 of the Exotic Ferns shows an extreme condition, in which the sori are numerous and paired, somewhat as in *A. carolinum*; but the specimen figured was doubtless taken from cultivation at Kew and is not typical. In the specimens cited below the occurrence of any sori at all upon the distal side of the pinnæ is decidedly unusual and the cutting of the pinnæ is very different from that of *A. carolinum*, as explained under that species.

Asplenium subalatum Hook. & Arn., the type of which is from Tepic, Mexico, differs in no respect from the usual form of *A. formosum*, as may be ascertained from the excellent plate. Plumier's figure, cited above with doubt, possibly represents this species as known to him from a small Martinique specimen. In this case the name *nanum*, having page priority over *formosum*, would technically have to replace the latter well-known name.

Asplenium formosum occurs usually, if not invariably, along watercourses, either upon rocky or solid earth banks. It is commonest at low or middle elevations (150 to 900 meters), but in Bolivia ascends to 1,800 meters. The following specimens (localities and habitat data here omitted) are in the U. S. National Herbarium:

JAMAICA: *Fredholm* 3255; *Clute* 279; *Maxon* 781, 825.

CUBA: *Wright* 854; *Britton, Earle & Wilson* 4733; *Shafer* 538; *Maxon* 3923.

HAYTI: *Nash & Taylor* 1222, 1346.

PORTO RICO: *Britton & Marble* 472; *Sintenis* 414.

DOMINICA: *Eggers* 844.

GUADELOUPE: *Duss* 4123, 4202.

MARTINIQUE: *Duss* 1651.

MONTSERRAT: *Turner*.

MEXICO: *Galeotti* 6471; *Langlassé* 350; *Jones* 527; *Rose & Painter* 6944; *Orcutt* 4638; *Purpus* 2178; *Liebmann*.

BRITISH HONDURAS: *Blancaneaux*.

GUATEMALA: *Heyde* 214; *Cook & Griggs* 673; *Deam* 6079; *John Donnell Smith* 1065 (*von Türckheim*), 1176 (*Walker*), 2444 (*J. D. S.*), 3222 (*Heyde & Lux*).

HONDURAS: *John Donnell Smith* 5678 (*Thieme*).

NICARAGUA: *Wright*.

COSTA RICA: *Cook & Doyle* 244; *Hitchcock* 8446a, 8458a; *Pittier* 914, 3070, 4446; *Tonduz* 8799, 9456, 12751; *Maxon* 582.

PANAMA: *Maxon* 4671; *Pittier* 4478.

COLOMBIA: *Lehmann* 6015; *H. H. Smith* 966.

VENEZUELA: *Fendler* 133.

BOLIVIA: *Williams* 1074, 1075.

BRAZIL: São Paulo, *Regnell* I 487; *Ulbricht*.

CEYLON: *Ex herb. Hope*.

NYASALAND: *Buchanan* 258.

KAMERUN: *Zenker & Staudt* 642.



FIG. 7. — *Asplenium castaneum*. Rhizome scales. Pringle's 6150. Scale 8.

14. *Asplenium carolinum* Maxon, sp. nov.

Rhizome erect or ascending, woody, about 5 mm. in diameter, somewhat sheathed by the persistent stipe bases of old fronds, the crown obscurely paleaceous, the scales rigid, linear-lanceolate, 1.5 to 2.5 mm. long, yellowish brown with a distinct dark brown median stripe; fronds 8 to 12, 10 to 20 cm. long, ascending, borne in a close vase-form crown; stipes short, stoutish (1 mm. thick or less), subterete, the anterior face narrowly sulcate, the ridges noticeably alate; lamina narrowly linear-oblong, 8 to 18 cm. long, 1.2 to 2 cm. broad, pinnate, rather abruptly acute at the apex, the lower portion more gradually reduced; pinnæ numerous, spreading, distant to adjacent, the lower ones deltoid, deeply parted, the lowermost minute; middle pinnæ 7 to 10 mm. long, 3 to 4 mm. broad, oblong from a broadly cuneate or subrectangular base, subauriculate by the incision of the upper margin near the base, the auricle or lobe distinctly 2 to 4 dentate, the upper margin elsewhere more or less deeply crenate-serrate or obliquely incised (the crenations simple or faintly bidentate), the lower margin entire in the proximal half, obliquely crenate toward the apex; veins 4 to 6 pairs, very oblique, the superior basal one 1 to 3 times forked, the others simple or (in the case of the larger bidentate crenations) forked at a very acute angle, all nearly concealed; sori 2 or 3 pairs, borne in the outer half or two-thirds of the pinna, elliptical, tumid, very oblique; indusia firm, ample, subentire. Leaf tissue firmly chartaceous, dull dark green, the lower surface minutely puberulent.

Type in the U. S. National Herbarium, no. 25611, collected upon Charles Island, one of the Galapagos group, by Leslie A. Lee, April 8, 1888, during the voyage of the U. S. Bureau of Fisheries Steamer *Albatross* (1887-1888).

Specimens which presumably are of this species have hitherto been reported from the Galapagos Islands as *Asplenium formosum*, of which *A. carolinum* is a close ally. This species differs from *A. formosum* principally in its obtuse and less deeply incised pinnæ, in having the crenations of the pinnæ simple or faintly dentate (instead of deeply and sharply cleft), and in its shorter and less oblique sori which are arranged in pairs, instead of in a single series upon the proximal side of the pinnæ. In all probability *Asplenium carolinum* is a derivative of *A. formosum* and the differences noted are doubtless to be associated with its isolation far from the mainland.

15. *Asplenium platyneuron* (L.) Oakes; D. C. Eaton, Ferns N. Amer. 1: 24. 1878.

Acrostichum platyneuron L. Sp. Pl. 1069. 1753, in part.

Asplenium ebeneum Ait. Hort. Kew. 3: 462. 1789.

Asplenium trichomanoides Michx. Fl. Bor. Amer. 2: 265. 1803.

Asplenium polypodioides Swartz, Journ. Bot. Schrad. 1800²: 53. 1801.

TYPE LOCALITY: Virginia.

DISTRIBUTION: Maine and southern Ontario to Florida, westward to Texas and Colorado. Also in South Africa.

ILLUSTRATIONS: Schkuhr, Krypt. Gewächs. 1: pl. 73 (as *Asplenium polypodioides*); D. C. Eaton, loc. cit. 1: pl. 4. f. 1 (as *Asplenium ebeneum*); Williamson, Ferns Kentucky pl. 17.

Among the species of this group *Asplenium platyneuron* is unique in having the fertile and sterile fronds very unlike each other in both form and stature. The relatively short sterile fronds (which are evergreen) form a basal rosette, radiating from the rhizome and lying close to the ground. The fertile fronds are tall and fewer in number and are borne stiffly erect from the center of the rosette. There is a good deal of variation in the degree of serration of the pinnæ, and several varietal forms have been described, one of the most pronounced being the variety *hortonae*, of New England. This has the pinnæ deeply pinnatifid, and in its extreme form is sterile. Plants with pinnæ irregularly and often deeply incised are not at all uncommon, especially in the southern United States, but these are only extremes of a tendency which may be noted in any region where this species is abundant, and numerous specimens occur which are intermediate in every respect.

Eaton's excellent plate should serve to identify this species without doubt. Nevertheless, Jenman, though citing it, has applied the name "*Asplenium ebeneum* Ait." to the very dissimilar Jamaican plant here described as *A. nesioticum*, as shown not only by his description but by specimens of the Jenman collection at the New York Botanical Garden. Sodiro also has erroneously applied the same name to certain specimens from the Andes of South America which have been regarded by Doctor Christ as a new species, *A. sodiroi*;¹ but additional specimens collected in Costa Rica by Tonduz (no. 12333) and included by Doctor Christ have herbaceous green stipes and clearly fall outside the limits of the *A. trichomanes* group. The South American element has not been seen by the writer.

The occurrence of *A. platyneuron* in South Africa gives this species a distribution which, while unusual, is not unprecedented; and specimens at hand from that region seem to be identical with the United States plant. Few of the species of this group are less exacting in requirements of habitat. It is often plentiful at the edge of moist, rich, rocky woods, but will be found again upon open sandy hillsides or less commonly in the chinks of cliffs of various formations. It appears to attain its best development along partially shaded or rather open rocky banks, often flourishing in large colonies among grasses and the rank growth of late summer. Photographs showing it in its natural surroundings, as well as illustrations of herbarium specimens, have been published in several books dealing with the ferns of the United States in a popular way within recent years. *Asplenium trichomanes* has been similarly treated.

Some doubt may reasonably be expressed as to the desirability of going back to the Species Plantarum of Linnæus for the species name *platyneuron*. The figures there cited under *Acrostichum platyneuros* pertain to *Polypodium vulgare* or *P. polypodioides*, and the only *Asplenium* element mentioned is contained in Gronovius's brief character:² ASCROSTICUM frondibus alternatim pinnatis, foliolis ovatis crenatis sessilibus, sursum arcuatis. Clayton's description, cited by Gronovius, is even briefer: *Trichomanes foliis minoribus, caule nigro splendente*; but as applied to a Virginia plant it describes an *Asplenium* rather than a *Polypodium*, and so may actually relate to the plant long known as *Asplenium ebeneum*. Eaton³ is authority for the statement that this species is not represented in the Linnæan herbarium under the name *Acrostichum platyneuros*. Clayton's plant, cited by Gronovius, should be in the British Museum; but Mr. A. Gepp, who has been good enough to search for it, states that it is not now to be found, although there is a Gronovian specimen rightly named and marked as coming from Carolina. This was probably the basis of Gronovius's description, adopted bodily by Linnæus (who published no description of his own), and so may stand as the type of *Acrostichum platyneuros*.

The later synonymy as cited above appears to be complete. Michaux's description of *A. trichomanoides*, though inadequate, seems to apply to *A. platyneuron*, as both Moore and Eaton have claimed. The amended description by Kunze,⁴ however, almost certainly applies to *A. resiliens*.

16. *Asplenium denudatum* Mett.; Kuhn, Linnaea 36: 93. 1869.

TYPE LOCALITY: "Andes Peruvianæ," the exact locality and collector's name not stated.

DISTRIBUTION: Mountains of Peru and Ecuador.

This species is known to the writer from a single imperfect specimen, this agreeing in nearly every particular with the original description. Superficially, in the shape of the pinnæ and character of the sori, it resembles *A. monanthes* rather closely, and

¹ Christ in Pittier, Prim. Fl. Costar. 3: 26. 1901.

² Gronov. Fl. Virg. 123. 1739.

³ Canad. Nat. 13: 25. 1870.

⁴ Amer. Journ. Sci. 6: 85. 1848.

badly abraded specimens lacking a rhizome probably could not always be distinguished from that species. The most distinctive points, both mentioned in the original description, are (1) the ferruginous rhizome scales and (2) the long articulate glandular-capitate hairs of the rachis. The first at once differentiates *A. denudatum* from all other species of this group, including *A. monanthes* which in all its forms has black or brownish scales. The second character also, though apparent only upon close examination, is nearly peculiar to this species, hairs very similar to these having been observed only upon several specimens of *A. castaneum*.

The following specimen, consisting of two fronds in the U. S. National Herbarium, is too incomplete to afford full data as to the usual position and arrangement of the sori:

ECUADOR: Without definite locality, Jameson.

17. *Asplenium monanthes* L. Mant. Pl. 1: 130. 1767.

PLATE 1.

Asplenium monanthes L. f.; Murray, Syst. Veg. 933. 1784.

Asplenium dentex von Buch, Besch. Canar. Ins. 189. 1825.

Asplenium menziesii Hook. & Grev. Icon. Fil. 1: pl. 100. 1829.

Asplenium polyphyllum Bertol. Nov. Comm. Acad. Bonon. 4: 443. 1840, not Presl ex Goldman, 1843.

Asplenium arcuatum Liebm. Dansk. Vid. Selsk. Skrivt. V. 1: 241. 1849.

Asplenium galeottii Fée, Gen. Fil. 192. 1852.

Asplenium leptophyllum Fée, Mém. Foug. 7: 50. 1857, not Swartz, 1791, nor Lag. 1802.

Asplenium blandulum Fée, Mém. Foug. 7: 51. 1857.

Asplenium polymeris Moore, Ind. Fil. 154. 1859.

Asplenium bertolonii Donn. Smith, Enum. Pl. Guat. 4: 189. 1895.

Asplenium trichomanes var. *viridissimum* Christ, Bull. Soc. Bot. Belg. 35: 195. 1896.

Asplenium viridissimum Bommer, Bull. Soc. Bot. Belg. 35: 195. 1896, as synonym.

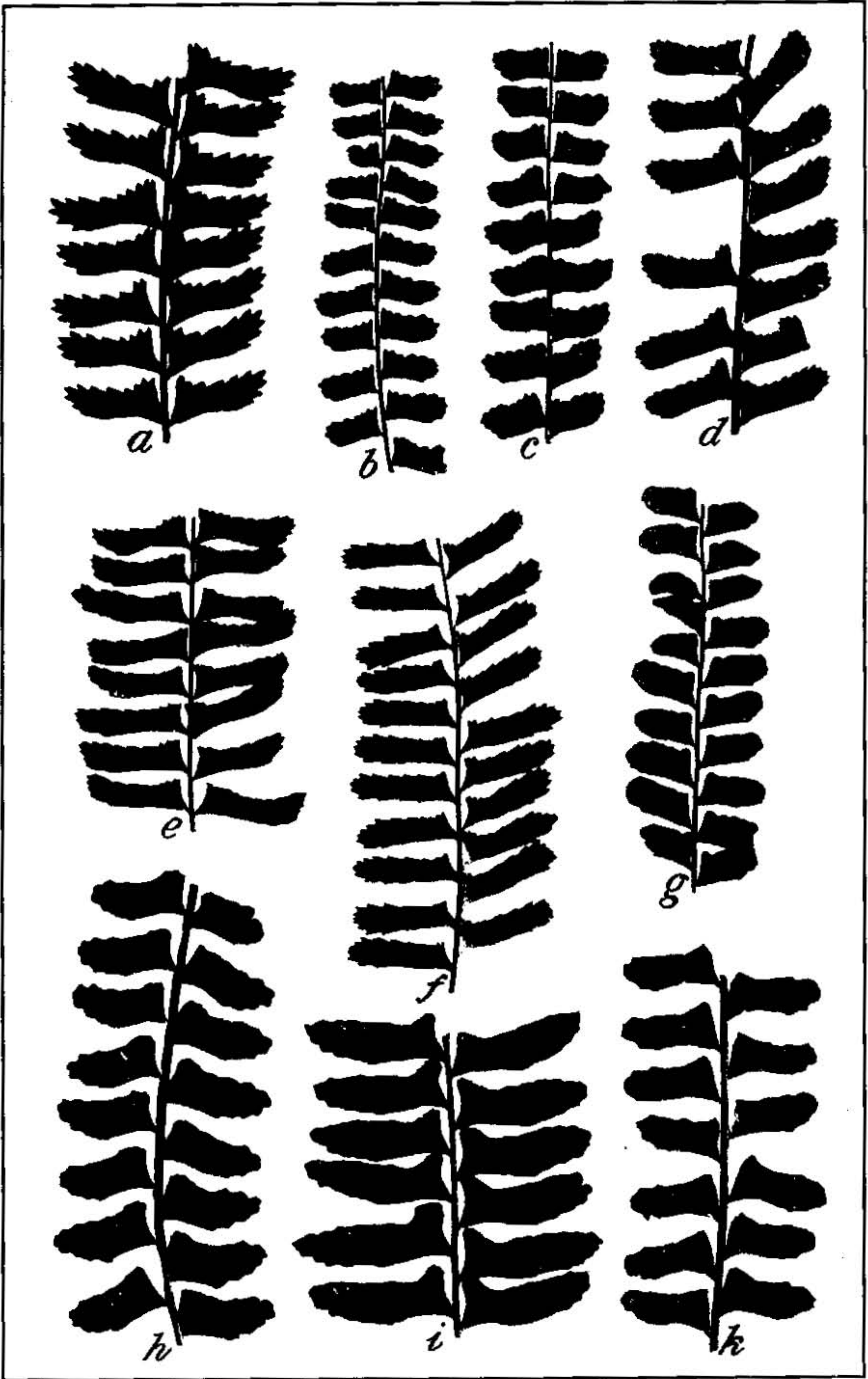
TYPE LOCALITY: South Africa.

DISTRIBUTION: Widely dispersed in Africa, including the Atlantic islands; upon the American continent extending from the Huachuca Mountains, Arizona, through Mexico and Central America to Chili; also in Jamaica and the Hawaiian Islands.

ILLUSTRATIONS: Lowe, Ferns Brit. Exot. 5: pl. 1. A (as *A. dentex*); Brack. in Wilkes, U. S. Expl. Exped. 16: pl. 20. f. 2 (as *A. monanthes*); Mett. Fil. Hort. Lips. pl. 9. f. 7, 8 (as *A. monanthes*); Fée, Mém. Foug. 7: pl. 16. f. 2 (as *A. galeottii*); Fée, loc. cit. 7: pl. 14. f. 2 (as *A. leptophyllum*).

The above synonymy, which is probably not complete, relates to the most variable species of this group and serves to indicate how many of its phases have been regarded as distinct species. The diversity of form is very great, and it is surprising, considering the wide geographical range, that no definite and recognizable lines of cleavage should have developed, separating its more isolated elements finally into obviously distinct species. The recognition of its forms even as subspecies seems rather undesirable, since in most cases they do not appear to occupy separate areas and because their extremes are for the most part apparently connected by numerous intermediates. Local conditions of environment seem to be unusually potent in determining size and fertility of individual plants and, consequently, size and shape of pinnae. The species is especially subject to variation in character and extent of sori, and an exceedingly interesting detailed morphological study might advantageously be made of this phase alone in its relation to leaf form and habitat. A few descriptive notes are here given, mainly in connection with the above synonymy.

The type of *Asplenium monanthes* is from the Cape of Good Hope, and though the original diagnosis refers to the sori as single and lying close to the lower margin neither of these characters is invariably true of South African material nor of plants from any other single region. (Two different collections from Natal and one from Madagascar are shown in pl. 1, figs. a, b, and c.) Plants with a single long sori or



FORMS OF ASPLENIUM MONANTHES L.

with a few sori near the lower margin usually come from dry bushy banks or open slopes, and are likely to have very narrow stiff fronds. According to Milde and others, the species is rather widely distributed in Africa. Specimens are at hand from Madagascar, Natal, German East Africa, and British East Africa, as well as from several of the Canaries and neighboring islands. *Asplenium dentex* was described from the Canaries and *A. blandulum* from the Cape Verde group. *Asplenium menziesii* is a name given by Hooker and Greville to the Hawaiian form of this species, but their description and plate have been held to apply equally well to South American specimens, which have been regarded as at most a variety of *A. monanthes*.

The two American species proposed by Fée are forms which at first appear sufficiently distinct. *Asplenium leptophyllum* was founded upon plants collected in Colombia by Schlim and in Mexico by Galeotti. These, as figured, will be seen to represent one of the common Mexican forms not unlike that which occurs in Arizona. *Asplenium galeottii* was founded upon specimens collected in Oaxaca by Galeotti (no. 6369). It is not common in Mexico, but occurs in both eastern and western Guatemala and in Costa Rica, and presumably also in the high mountains of the intervening territory. Intermediates between Fée's two "species" are of frequent occurrence, as, for example, the Guatemalan plant shown in plate 1, figure *d*, and the Mexican plant shown in plate 1, figure *e*.

Another Mexican form which has been collected by Palmer, Pringle, and others¹ is that illustrated in plate 1, figure *f*. This has the characteristic middle pinnæ linear-oblong, 12 to 17 mm. long, subauriculate, the auricular portion sharply dentate-serrate, the serrations usually becoming more oblique and continuing around the otherwise blunt apex, being noticeable upon the lower margin fully half the distance toward the base. The sori are rather short and arranged in 3 to 5 pairs, the upper line of sori usually being nearly as complete as the lower. This form was regarded by so careful a field observer as Mr. Pringle as representing a species distinct from *A. monanthes*. Specimens are at hand, however, representing a complete transition into the form called *A. leptophyllum* by Fée. *Asplenium arcuatum* represents one of these intermediates, as is proved by several fronds of Liebmann's original specimens received from Copenhagen.

Still another Mexican form is that indicated in plate 1, figure *g*. It is not very common and is chiefly remarkable for its congested appearance, largely owing to the sori being numerous, long, and close-set, nearly covering the surface of the pinnæ.

The most remarkable phase of all is that found upon several of the high volcanoes of western Guatemala and Costa Rica. This was first described under the name *Asplenium polyphyllum*² by Bertoloni in 1840 from the volcano Agua, Guatemala. Specimens from the type locality, where it is abundant³ in the moist forested zone

¹ Rio Blanco, State of Jalisco, *E. Palmer* 562, in 1886; cool banks, Eslaba, Federal District, *Pringle* 8754; Santa Rosa, Guanajuato, *Dugès* 25, in 1905.

²*Asplenium polyphyllum* Presl, relating to plants from Manila and Oahu, was published as a *nomen nudum* in 1836 and was not associated with a description until 1843 (Goldman in Nov. Act. Acad. Caes. Leop. Carol. 19: Suppl. 1: 462. 1843). In the meantime (in 1840) Bertoloni had fully described a Guatemalan plant under this name. There was thus no need of the new name *A. polymeris* published by Moore for the Guatemalan plant in 1859. Captain Smith also renamed the Guatemalan plant *A. bertolonii*, presumably upon the same ground erroneously taken by Moore, namely, that the name *polyphyllum* must date from 1836.

³The following specimens are in the U. S. National Museum: Volcan de Agua, Guatemala, alt. 2,700 to 3,300 meters, in moist shaded thickets or rarely on shaded banks, *Maxon & Hay* 3674, 3725, 3729, 3732, 3733, 3733a, 3734, 3737, 3741; *John Donnell Smith* 2447. The same form was also collected in the Department of Quiché, Guatemala, above 3,000 meters by Heyde and Lux and distributed by Captain Smith as no. 3225.

between 2,700 and 3,300 meters, are figured in plate 1, figures *h*, *i*. Similar specimens from the Volcano Barba, Costa Rica (*Pittier* 1937), shown in plate 1, figure *k*, were regarded by Bommer as a valid species, *Asplenium viridissimum*, and were described by Christ as *A. trichomanes* var. *viridissimum*. These plants of the high mountains of Guatemala and Costa Rica represent in most respects the highest development of the species. Many of the individuals are more than a meter tall, the fronds usually numerous and closely imbricate upon a stoutish suberect rhizome, the rachises stout (from 1.5 to 2.5 mm. in diameter) and strongly winged upon the upper side. The pinnæ are numerous (60 to 80 pairs), the middle ones mostly oblong to narrowly oblong from a strongly inequilateral often narrowly cuneate base, strongly auriculate above, the lower side evenly excised about half the distance to the rounded or often subspatulate apex. The margins vary from crenate to lightly crenate-serrate, according to the fertility of the pinnæ. The sori are 4 to 6 pairs in number, oblique, crowded, and borne mainly in pairs throughout, excepting only the auricle which bears none, or rarely more than one sorus. The indusia are firm, whitish, even-margined, and persistent, relatively narrower than in *A. castaneum*, and at maturity are mostly concealed by the masses of dark brown sporangia, which indeed commonly suffuse the whole under surface of the pinnæ. Nearly all the fronds are minutely viviparous near the apex, but no buds have been noted upon the stipe or lower part of the rachis, as is common in ordinary forms of *A. monanthes*.

This form is a striking one, differing very materially from most conditions of *A. monanthes*, and may represent a valid species. It is nearest to the form described as *A. galeottii*, but no true intermediates have been seen. In view of the wide extent of variation existing among the forms which are known positively to belong to *A. monanthes*, however, it scarcely seems desirable to recognize as distinct this Costa Rican and Guatemalan plant, which is only a little more extreme than several other phases. No species retaining the common characters of this group could appear to be more polymorphic than *A. monanthes*; and it is possible that a further investigation may show not only "*A. polyphyllum*" but other of the forms here enumerated and figured to be improperly associated under a single species. The various phases or races are, however, closely allied among themselves and do not merge into any of the species separately listed; so that a future subdivision of *A. monanthes* as here treated need not involve a realignment of the other species.

EXPLANATION OF PLATE 1.—Various forms of *Asplenium monanthes* L.: *a*, specimen from Natal, *Buchanan*; *b*, Mount West, Natal, alt. 960 meters, *Schlechter* 6821; *c*, Madagascar, *Hildebrandt* 3591; *d*, Volcan de Agua, Guatemala, alt. 2,700 to 3,000 meters, *Maxon* 3739; *e*, Teziutlan, Puebla, Mexico, *Orcutt* 3987; *f*, Eslaba, Federal District, Mexico, alt. 2,350 meters, *Pringle* 8754; *g*, near Cima, State of Mexico, *Rose & Painter* 7204; *h*, Volcan de Agua, Guatemala, alt. 2,700 to 3,000 meters, *Maxon* 3733; *i*, same locality, *Maxon* 3732; *k*, Volcan de Barba, Costa Rica, alt. 2756 meters, *Pittier* 1937. All are shown at natural size.

18. *Asplenium melanorachis* C. Chr. Ind. Fil. 121. 1905.

Asplenium nigricans D. C. Eaton, Proc. Amer. Acad. 8: 619. 1873, not Kunze, 1834.

TYPE LOCALITY: Chiapas, Mexico, on the trunks of large trees, in the borders of forests (*Ghiesbreght* 377).

DISTRIBUTION: Known only from the original collection.

This species was well characterized by Eaton. Its relationship is discussed briefly under the following new species:

19. *Asplenium kellermanii* Maxon, sp. nov.

Fronds several, about 50 cm. long, ascending; rhizome erect or suberect, stoutish, obscurely paleaceous, the scales lance-attenuate, opaque, 1.5 to 2 mm. long; stipes stout (about 1.5 mm. in diameter), dark reddish brown, lustrous, nearly terete, 25 to 30 cm. long; lamina narrowly oblong, about 25 cm. long, 5 to 9 cm. broad, simply pinnate, the rachis similar to the stipe, but the upper surface sulcate, narrowly alate; pinnæ 7 or 8 pairs, opposite or subopposite, sessile, subequal, the upper ones scarcely

reduced, the terminal segment conform or sometimes hastate and greatly enlarged; basal pinnæ opposite, deltoid, very broadly and subequally cuneate or nearly truncate, 2 to 2.7 cm. long, about 2 cm. broad; middle pinnæ 3.5 to 4.5 cm. long, 1.5 to 2.5 cm. broad above the broadly cuneate inequilateral base, asymmetrically deltoid or subtrapeziform, the apical portion triangular, acute; margins crenulate, distantly so toward the apex of the pinnæ; venation subflabellate, the basal veins several times dichotomous, the others once or twice forked, very oblique, the branches nearly equal; sori 4 or 5 pairs, linear, 5 to 9 mm. long, very oblique, distinctly inframedial but usually extended along the anterior branch of the vein; indusium linear, about 1 mm. broad, fragile, entire, grayish brown; leaf tissue rigidly herbaceo-chartaceous, dull grayish green, discolored in drying, opaque, the venation distinctly visible only by transmitted light.

Type in the U. S. National Herbarium, no. 691213, collected on the Volcano Atitlán, Department of Sololá, Guatemala, February 16, 1906, by Prof. W. A. Kellerman (no. 5792).

Asplenium kellermanii departs very widely from the typical members of the group of *A. trichomanes* and perhaps ought not to be associated with them. It represents, in fact, one extreme of a series containing the large forms of *A. monanthes* as the other extreme, with *A. melanorachis* occupying an almost exactly intermediate position. From *A. melanorachis* it differs conspicuously in the characters enumerated in the key, and also in its paired sori, its subequal pinnæ (the upper ones not or scarcely at all reduced), and in its large terminal segment. *Asplenium melanorachis* itself is specifically distinct from *A. monanthes*, yet in its general habit, elongate-oblong pinnæ, and inferior sori it shows clearly an alliance with that species. It is said by Ghiesbreght to have grown upon the trunks of large trees. *Asplenium kellermanii* is terrestrial.

THE NORTH AMERICAN TREE FERNS OF THE GENUS DICKSONIA.

In the last paper of this series the writer published a key to the North American species of *Cibotium*, with notes upon the taxonomic history of the several species, which had been very generally confused. Related to *Cibotium* is the genus *Dicksonia*, whose species also have been widely misunderstood. The main differences between the two genera have recently been summarized in a nontechnical article¹ upon the tree ferns of North America. It is there pointed out that in *Dicksonia* the leaf blades are narrowly elongate and either lanceolate or oblanceolate, the lower pinnæ gradually reduced in size, while in *Cibotium* the blades are very much more ample and of a broadly ovate or deltoid type; a feature which is fully as important as the technical distinctions drawn from the indusia. The peculiar bivalvate indusium of the tribe *Dicksonieae* is also discussed briefly, reference being made to that of *Cibotium* as the most highly differentiated of any of the tribe, since in this genus the outer lip, like the inner, is manifestly cartilaginous. In *Dicksonia*, on the other hand, the outer concave lip consists merely of the leaf tissue of a small marginal lobule of the leaf segment, which is only slightly modified

¹ Ann. Rep. Smiths. Inst. 1911: 463-491. pls. 1-15. 1912.

by its function as a partial covering for the sporangia. In both these genera, however, the true indusium is the inner yellowish or yellowish brown lip, which is rigidly cartilaginous, that of *Dicksonia* being rounded and more nearly hemispherical than that of *Cibotium*.

In the *Dicksonieae* the species are much more difficult to distinguish than in the tribe *Cyatheae*, partly because there is a less appreciable difference in cut of leaf, and partly from the almost complete absence of special structures (various types of scales and hairs) which serve to distinguish the species of the *Cyatheae*. Moreover, the branching of the veins is more variable and more directly correlated with degrees of fertility. Upon superficial examination merely it would be possible to so arrange the American forms of *Dicksonia* in a single series that they might appear to represent but a single polymorphic "species," with several outlying forms. Thus, to an unusual degree the study of this genus must be a comparative one, dealing with a large series of specimens from as many localities as possible. This is rendered difficult, however, by the fact that the genus is apparently represented in America by few species and that individuals are not only of infrequent occurrence but are found usually in inaccessible heavily forested regions.

But two species of *Dicksonia* have been ascribed to North America in recent years, *D. lobulata* and *D. navarrensis*, both described from Costa Rica by Dr. H. Christ. The first appears to be a valid species, and the second to be synonymous with the South American *D. gigantea* Karst. To these are here added two more: *D. karsteniana*, long ago mentioned from Costa Rica by Karsten, and *D. ghiesbreghtii*, now described from Chiapas. Descriptions of all four will appear in the second part of volume 16, *North American Flora*. There are indications of two other species also, as noted below. The several species now recognized may be separated by the following key:

KEY TO SPECIES.

Veins usually 5 or 6 pairs; fertile veins simple or sometimes once forked.

Fertile segments 4 to 4.5 mm. broad; fertile veins simple; sori about 1.5 mm. broad 1. *D. lobulata*.

Fertile segments 3 to 3.5 mm. broad; fertile veins simple or the proximal ones frequently once forked; sori about 1 mm. broad 2. *D. gigantea*.

Veins 7 or 8 pairs; fertile veins mostly once or twice forked.

Fertile segments 4 to 5 mm. broad; fertile veins once or commonly twice forked 3. *D. karsteniana*.

Fertile segments 3 to 3.5 mm. broad, appearing much narrower than the preceding, the lobes also narrower; fertile veins usually once forked 4. *D. ghiesbreghtii*.

1. *Dicksonia lobulata* Christ, Bull. Herb. Boiss. II. 6: 187. 1906.

TYPE LOCALITY: Cerros de Velirla, Copey, Costa Rica, altitude 2,600 to 2,700 meters.

DISTRIBUTION: Known only from Costa Rica.

Three sheets of the type number (*Tonduz* 11789) are in the U. S. National Herbarium, and the species is probably known only from this collection. The venation is that ascribed by Karsten to *Dicksonia gigantea*, but the plant differs materially from that species in its broader and more obtuse segments, as well as in its larger sori.

2. *Dicksonia gigantea* Karst. Fl. Columb. 2: 177. 1869.

Dicksonia navarrensis Christ, Bull. Herb. Boiss. II. 6: 188. 1906.

TYPE LOCALITY: Mount Guadalupe, Andes of Bogota, Colombia, altitude 2,600 meters.

DISTRIBUTION: High mountains of Colombia, Panama, and Costa Rica.

ILLUSTRATION: Karst. loc. cit. *pl.* 193; Ann. Rep. Smiths. Inst. 1911: *pl.* 13. *f.* B, *pl.* 14 (as *D. navarrensis*).

A comparison of authentic material of *Dicksonia navarrensis*, both of Wercklé's original collection and a more ample series collected near the type locality by the writer in 1906, with Karsten's description and illustration of *D. gigantea* leaves scarcely any doubt that they represent a single species. More recently gathered material from Chiriqui, Panama, strengthens this conclusion. Not all fertile segments have simple veins, however, as supposed by Karsten. This is particularly true of the larger, fully fertile segments of the lower and middle parts of the pinnule, in which the fertile veins of the proximal side of the segment are frequently once forked, while those of the distal side are almost invariably simple. The branches of the veins are delicate, however, and inconspicuous, their development being accompanied by only a slight crenation of the fertile lobes.

Dicksonia gigantea is much more closely related to *D. lobulata* than to *D. karsteniana*, as indicated in the key.

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

COSTA RICA: Without definite locality, *Wercklé* (4 sheets, *ex herb. Christ*). Without locality, *J. J. Cooper* (3 sheets). Mountains 5 miles south of Cartago, alt. 1,800 meters, *Maxon* 513; *Maxon* 528.

PANAMA: Humid forest between Alto de los Palmas and Cerro de la Horqueta, Chiriqui, alt. 2,100 to 2,268 meters, March 18, 1911, *Maxon* 5513.

3. *Dicksonia karsteniana* (Klotzsch) Karst. Fl. Columb. 2: 179. 1869.

Balanium karstenianum Klotzsch, *Linnaea* 20: 444. 1847.

TYPE LOCALITY: Colombia.

DISTRIBUTION: Wet forests of the high mountains of Venezuela, Colombia, and Costa Rica.

ILLUSTRATION: Karst. loc. cit. *pls.* 194, 195. *f.* 7-17.

Known to the writer chiefly from Costa Rica specimens collected in the vicinity of Coliblanco, upon the slopes of the Volcano Turrialba, altitude about 1,950 meters (*Maxon* 325), which agree fairly well with Karsten's illustration and with fragmentary South American and Costa Rican material in the Underwood Fern Herbarium at the New York Botanical Garden. Its relationship is apparently with *Dicksonia ghiesbreghtii*, from which it differs in the characters noted under that species.

4. *Dicksonia ghiesbreghtii* Maxon, sp. nov.

Caudex 4 to 5 meters high; fronds essentially tripinnate; primary rachis not seen; primary pinnæ linear-oblong, acuminate, not strongly asymmetrical, 60 to 70 cm. long, about 20 cm. broad, the secondary rachis 2 mm. thick, dull light brownish, slightly rough from the partial abrasion of the articulate turgid dirty yellow capillary scales; pinnules numerous, contiguous, alternate, sessile, inserted 2 to 2.5 cm. apart upon each side of the rachis, linear-oblong, long-acuminate, 8 to 12 cm. long, 2 to 2.5

cm. broad, the costa prominent, sparingly clothed below with spreading capillary scales like those of the secondary rachis, above scantily short-strigose; segments 20 or more pairs below the long-acuminate deeply serrate apex, linear-oblong, straight or apically subfalcate, short-acuminate, 10 to 15 mm. long, 3 to 3.5 mm. broad (or narrower by the curvature of the margins in drying), varying from sessile at the base of the pinnule to adnate and slightly decurrent in the outer part; sterile segments serrate to sharply and obliquely incised; fertile segments pinnatifid about two-thirds the distance to the costule, the lobes cucullate, usually broader than long, rounded, often slightly emarginate; costules elevated, those of the fertile segments bearing persistent capillary scales below; veins 7 or 8 pairs, those of the sterile segments mostly once or twice forked, those of the fertile segments sometimes simple, usually once forked, the sorus borne at the end of the distal branch, the other branch evident as a short spur immediately below; sori mostly 4 or 5 pairs, occupying the lower two-thirds of the segment, about 1 mm. broad; paraphyses numerous, rather long, flaccid, light brownish.

Type in the U. S. National Herbarium, no. 690479, collected in the temperate mountain region of Chiapas, Mexico, 1864-70, by Dr. A. Ghiesbreght (no. 353). This number was determined by Hall¹ as *Dicksoniana sellowiana* Hook., a South American species, from which it is widely different. More recently Doctor Christ has reported² (as *Cibotium wendlandi* Mett.) a plant from El Zontehuitz, Chiapas, altitude 2,858 meters, *Munch* 104, which may prove to be this species.

Dicksonia ghiesbreghtii is allied to *D. karsteniana*, from which it differs especially in its narrower segments and simpler venation, as well as in the narrower lobes of the segments and in having a rather noticeable covering of stiffish, turgid, short-celled hairs upon the costules.

DOUBTFUL MATERIAL.

There are at hand also the following specimens whose status can not be determined satisfactorily at present:

1. United States National Herbarium nos. 575152 and 830655, collected from "forêts de l'Achiote," Volcano Poas, Costa Rica, altitude 2,200 meters, November, 1896, by A. Tonduz (no. 10697). This number has been mentioned several times³ by Doctor Christ as a species of *Cibotium*, being referred by him (apparently with some doubt) to *C. wendlandi*, although, as pointed out by the writer recently,⁴ it really represents a species of *Dicksonia*. The aspect of these specimens is different from that of any North American species and rather strongly suggestive of larger states of *D. sellowiana* from Brazil. Further material from Poas will probably indicate the specific distinctness of this form.

2. United States National Herbarium no. 676144, collected near the summit of the Divide, above Camp I, Holcomb's trail, above El Boquete, Chiriqui, Panama, altitude about 1,900 meters, by William R. Maxon (no. 5668), March 23, 1911. This, which may be a form of *D. gigantea*, is notable for its narrower and more spreading pinnules, blunter and simpler segments, muriculate rachises, etc. Certain individuals in this locality, which were supposed to be of the same species, had trunks fully 6 meters high.

¹ Hall, Franklin W. *Catalogue of a Collection of Ferns made in Southern Mexico, mainly at Chiapas, by Dr. A. Ghiesbreght, in the years 1864-70.* pp. 10. New Haven, Connecticut. 1873.

² *Bull. Herb. Boiss.* II. 5: 251. 1905; 5: 734. 1905. (See *Contr. U. S. Nat. Herb.* 16: 57. 1912.)

³ *Bull. Herb. Boiss.* II. 5: 734. 1905; 6: 189. 1906; 7: 273. 1907.

⁴ *Contr. U. S. Nat. Herb.* 16: 57. 1912.

THE GENUS ODONTOSORIA.

The genus *Odontosoria*, as recognized by Diels in the Pflanzenfamilien of Engler and Prantl,¹ comprises two sections or subgenera, the first (Eu-*Odontosoria*) containing rather small species of erect or ascending habit and determinate growth,² the second (*Stenoloma*) containing three species of indefinite scandent growth. These two groups are entitled to recognition as distinct genera. Adopting this view, it is necessary to apply the name *Odontosoria* to the second group, the large climbing species, rather than to the first. The grounds for this treatment are presented in the following brief account of the taxonomic history of the genus, with a review of the American species of true *Odontosoria*.

Presl³ appears to have been the first to use the name *Odontosoria*, his application of it being to an assemblage of 17 species constituting his fourth section of the genus *Davallia*. Included among these are species of both types mentioned above. Naturally, the simpler, smaller plants of upright, determinate growth are listed first, and one of these (*Davallia tenuifolia* Swartz) is figured.⁴ Since this is the only species of this subgenus illustrated by Presl it might reasonably have been taken by later authors to typify the subgenus.

Fée, however, who was the first to take up the name *Odontosoria* in a generic sense,⁵ applied it to a single species, *O. uncinella* (Kunze) Fée (*Davallia uncinella* Kunze), which had not been published until 1850. Under past and current botanical rules the name *Odontosoria* must be applied according to Fée's use of it, and the type will therefore be *O. uncinella*. Most of the species of Presl's section *Odontosoria* were placed together by Fée under his new genus *Stenoloma*, and no distinctions were drawn as to the remarkably diverse habits of growth of the species thus included.

John Smith, writing of the ferns of Hongkong in 1857,⁶ reported upon three species of *Odontosoria* (*O. tenuifolia*, *O. chinensis*, and *O. retusa*),⁷ and added notes upon their generic characters. Later in the same year he elsewhere⁸ characterized the genus more fully, mentioning the fronds as "1 to 5 feet long, erect or flexuose, scandent," and listed two species in cultivation, *O. tenuifolia* and *O.*

¹ Pflanzenfam. 14: 215. 1899.

² By error Diels includes here also *O. schlechtendahlia*, which is clearly of the second group.

³ Tent. Pter. 129. 1836.

⁴ Loc. cit. pl. 4. f. 27.

⁵ Gen. Fil. 325. 1852.

⁶ In Secm. Bot. Voy. Herald 429. 1857.

⁷ The first two are forms of a single Old World species.

⁸ Cat. Ferns 66. 1857.

aculeata. In 1866¹ he more exactly describes the fronds as "erect or flexuose and scandent," and lists three species, *O. tenuifolia*, *O. aculeata*, and *O. clavata*, the first and last being of the small erect type, the second of the climbing sort. In 1875² he adopts the same point of view, though definitely assigning *O. tenuifolia* as the type of the genus, and, after stating that about a dozen widely distributed tropical species constitute the genus, remarks that "they form two distinct groups, the first having definite fronds and the other scandent and indefinite, the latter forming the genus *Stenoloma* of Fée." (As a matter of fact, Fée's *Stenoloma* included plants of both sorts, as already stated.) Smith makes no mention of *O. uncinella*, the type of Fée's genus *Odontosoria*. In fact, he credits the genus *Odontosoria* to "Presl (1836)," ignoring the fact that the name was used by Presl only in a sectional or subgeneric sense. From this false standpoint he was correct in typifying the genus upon *O. tenuifolia*; but, as pointed out above, the genus must really date from Fée, with *O. uncinella* as its type.

The next writer to deal with this group was Kuhn,³ who in 1882 properly distinguished the plants of indefinite scandent growth as a distinct generic group, but assigned to them the new name *Lindsayopsis*, listing three species: *Lindsayopsis divaricata* (Schlecht.), *L. aculeata* (L.), and *L. scandens* (Desv.). Since these species, however variable in indusium characters, are clearly congeneric with *O. uncinella*, the name *Lindsayopsis* becomes a synonym of *Odontosoria* Fée. The small species of upright growth are referred by Kuhn to no less than three genera, *Lindsaya* Dry., *Schizoloma* Gaud., and "Odontosoria Presl." Under *Odontosoria* he lists three species, one of them being *O. chinensis* (L.), which is the same as *Davallia tenuifolia* Swartz, the type of Presl's original subgenus *Odontosoria*.

Thus, not only John Smith but Kuhn and more recently, Diels⁴ have wrongly credited the genus to Presl and perhaps on this account have either directly or by implication typified it erroneously upon *Davallia tenuifolia*, instead of *O. uncinella*.

The systematic relationship of the many species listed by Kuhn under *Lindsaya* (43 species), *Schizoloma* (25 species), and *Odontosoria* (3 species) needs to be carefully investigated; but it is apparent that the plants called *Odontosoria chinensis* and *O. clavata* by Smith, Diels, Christensen, and most recent authors (the *Trichomanes chinensis* and *Adiantum clavatum*, respectively, of Linnæus) have no place under *Lindsaya*, *Schizoloma*, or, in its properly restricted sense, *Odontosoria*. For their accommodation the writer has proposed

¹ Ferns Brit. & For. 232, 317. 1866.

² Hist. Fil. 263. 1875.

³ Gruppe Chaetop. 25-27. 1882.

⁴ In Engl. & Prantl, Pflanzenfam. 1⁴: 215. 1899.

recently¹ the new genus *Sphenomeris*, with the West Indian *O. clavata* as its type, *Sphenomeris clavata*. Besides the common Old World species *Sphenomeris chinensis*² and the Philippine *S. retusa*³ there are several others to be removed hither from so-called *Lindsaya* and *Schizoloma*.

From the above it will appear (1) that Kuhn was the first, and up to the present has been the only one, to recognize the coherence of the climbing indeterminate "Davallias" as a distinct generic group; (2) that his error was mainly one of taxonomic practice in applying to this the new name *Lindsayopsis*, whereas it should have retained the name *Odontosoria*; (3) that the small group of species typified by *Odontosoria clavata* and *O. chinensis* of authors is to be recognized as a distinct genus, *Sphenomeris*, allied to *Odontosoria*, *Lindsaya*, and *Schizoloma*.

Even the commoner species of *Odontosoria* have been subject to much misidentification, which, considering their peculiar morphology, is not remarkable. Most of the confusion centers upon the varying application of the Linnæan name *aculeatum* in the past, as discussed at some length below. In lieu of complete descriptions of all the species the following key is made rather more full than would otherwise be necessary.

ODONTOSORIA (Presl) Fée.

Odontosoria (Presl) Fée, Gen. Fil. 325. 1852.

Davallia § *Odontosoria* Presl, Tent. Pter. 129. 1836, in part.

Relatively large plants of scandent habit, the fronds ascending, elongate, of indeterminate growth, the opposite primary pinnæ borne in acropetal succession. Rhizomes slender (2 to 4 mm. in diameter), woody, creeping, densely paleaceous, more or less freely branched. Fronds elongate-deltoid to linear, up to 6 meters long, the primary rachis woody, subterete to trigonous, smooth or variously spiny; lamina bipinnate to quadripinnate, in most species finely dissected, the ultimate pinnules variously lobed, cleft, or parted, the straight or usually flexuous rachises spiny or, in a few species, unarmed; veins forked, free; sori terminal, 1 to 3 to each ultimate segment, more or less endophyllous, the indusium either wholly joined to the scarcely different opposed leaf lobe and forming an urceolate or obconical involucre open only at the leaf margin, or in some species partially free at the sides, the involucre then slightly bilobed; spores triplanate.

Type species, *Odontosoria uncinella* (Kunze) Fée.

KEY TO THE SPECIES.

Plants provided with stout to slender spines upon some or all of their rachises.

Ultimate (terminal) divisions relatively coarse, cuneiform, narrowly deltoid, obovate, or rhombic from a sharply cuneate to inequilateral rectangular base, variously cleft, lobed, or incised, the lobes not monosorous.

¹ Journ. Washington Acad. Sci. 3: 144. 1913.

² *Adiantum chinense* L. Sp. Pl. 1099. 1753.

³ *Davallia retusa* Cav. Descr. Pl. 278. 1802.

- Fronde relatively small, tripinnate, the primary pinnæ comprising 1 to 4 pairs of distant linear once-pinnate lateral branches and a similar elongate terminal one..... 1. *O. uncinella*.
- Fronde very much larger, essentially quadripinnate, the secondary pinnæ ovate to deltoid, mostly imbricate, numerous, the apical ones gradually smaller.
- Rachises (the primary ones excepted) divaricately flexuous, conspicuously spiny nearly throughout.
- Pinnules of the fourth order irregularly rhombic, consisting of 2 to 4 cuneate-deltoid segments, these sharply cleft in the middle, each lobe emarginate and bisoriolate; spines long, acicular, spreading..... 2. *O. aculeata*.
- Pinnules of the fourth order rhombic to irregularly obcordate, simple, or the larger ones with 1 or 2 large free obcordate lateral segments, the terminal segment subrhombic, irregularly 1 or 2-lobed; sori several to each lobe; spines short, stout, retrorse..... 3. *O. jenmani*.
- Rachises straight; spines minute and few, mostly confined to the tertiary rachises.. 4. *O. flexuosa*.
- Ultimate (terminal) lobes or divisions narrow, linear to oblong or slightly clavate (never rhombic, ovate, or deltoid), usually monosorous, or, if cleft at the apex, each portion soriferous.
- Rachises beset with long spreading acicular spines.. 5. *O. wrightiana*.
- Rachises beset with conical mainly retrorse spines.
- Fronde relatively small, skeleton-like, about 70 cm. broad; ultimate divisions almost capillary, 0.2 to 0.5 mm. broad..... 6. *O. colombiana*.
- Fronde much larger (1 to 1.4 meters broad), distinctly leafy in appearance; ultimate divisions much larger, 0.7 to 1.5 mm. broad; spines stouter.
- Segments of the fifth order mostly flabelately parted, sharply cuneate, the 2 to 4 slender scarcely clavate divisions small, acutely joined; spines of the secondary rachis scattered, the larger ones 3 to 4 mm. long..... 7. *O. fumaroides*.
- Segments of the fifth order once to three times forked (often appearing twice dichotomous), the 2 to 4 distinctly clavate divisions widely divaricate; spines of the secondary rachis numerous, short (not exceeding 1.5 mm.)..... 8. *O. gymnogrammoides*.

Plants wholly unarmed.

Ultimate (terminal) divisions almost capillary, divaricate, 0.3 to 0.5 mm. broad (not broader than the narrowly foliaceous-marginate costæ), linear, or slightly clavate at the monosorous apices 9. *O. schlechtendahlia*.

Ultimate (terminal) lobes broader, shorter, foliaceous, 0.6 to 1.0 mm. broad, not distinct, cuneately joined in pairs, these again acutely joined, the segments thus in general 2 to 4 times flabellately parted or cleft, invariably cuneate 10. *O. guatemalensis*.

1. *Odontosoria uncinella* (Kunze) Fée, Gen. Fil. 326. 1852.

Davallia uncinella Kunze, Bot. Zeit. 8: 213. 1850.

Microlepia uncinella Mett. Fil. Hort. Lips. 103. 1856.

Lindsaya uncinella Krug, Bot. Jahrb. Engler 24: 92. 1897.

TYPE LOCALITY: Province of Santiago [Oriente], Cuba, altitude 1,200 meters (*Linden*).

DISTRIBUTION: Cuba and Porto Rico, ascending to 1,200 meters.

ILLUSTRATIONS: Fée, loc. cit. pl. 27 B. f. 1; Kunze, Farrnkr. 2: pl. 140 (as *Davallia uncinella*).

Specimens of the type collection of this species have not been seen by the writer. The description and figures cited above serve to distinguish it very well, however, and there is ample material also from the type region of eastern Cuba. The leaf tissue is thick and rigidly herbaceous, and in other respects the plant shows its affinity to the Jamaican species here called *Odontosoria jenmani*, which in error has gone latterly under the name *O. aculeata*.

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

CUBA: Without definite locality, *Wright* 899. Upper slopes and summit of Gran Piedra, alt. 900 to 1,200 meters, climbing on tree trunks and on banks, April 14, 1907, *Maxon* 4046. Damp thickets, Rio Guayabo, above the Falls, Oriente, alt. 450 to 550 meters, *Shafer* 3629. Bushes along trail, Rio Yamanigüey to Camp Toa, Oriente, alt. 400 meters, *Shafer* 4012. Camp La Gloria, south of Sierra Moa, Oriente, *Shafer* 8155.

PORTO RICO: Mount Viva Christo, between Adjuntas and Guayanilla, at border of forest, *Sintenis* 4600. Mount Morales, near Utuado, in primeval forest, *Britton & Marble* 1457.

2. *Odontosoria aculeata* (L.) J. Smith, Cult. Ferns 67. 1857.

Adiantum aculeatum L. Sp. Pl. 1096. 1753, in greater part.

Davallia aculeata J. E. Smith, Mém. Acad. Sci. Turin 5: 415. 1793, in part.

Davallia dumosa Swartz, Syn. Fil. 135, 353. 1806.

Stenoloma dumosum Fée, Gen. Fil. 330. 1852, as to name only.

Stenoloma aculeatum Fée, Gen. Fil. 330. 1852, excluding reference to Sloane's plate.

Microlepia aculeata Mett. Fil. Hort. Lips. 103. 1856, as to description, in part, and excluding reference to Hook. pl. 54. B.

Lindsaya aculeata Mett. Ann. Sci. Nat. IV. Bot. 15: 65. 1861.

Lindsayopsis aculeata Kuhn, Gruppe Chaetop. 27. 1882.

TYPE LOCALITY: "Spiny bottom," near Leogane, Haiti (*Plumier*).

DISTRIBUTION: Santo Domingo, eastern Cuba, and Porto Rico, extending to 1,190 meters altitude.

ILLUSTRATIONS: Plum. Trait. Foug. pl. 94; Spreng. Anleit. Gewächs. 3: pl. 5. f. 37 (as *Adiantum aculeatum*); Fée,¹ loc. cit. pl. 27 bis. A. f. 4? (as *Stenoloma aculeatum*).

¹ Fée's illustration (pl. 27 bis. A. f. 4), cited above, may not represent true *O. aculeata*. It is characteristic of that species in everything save spines, and these are perhaps not drawn correctly. Usually the spines are straight and acicular, but in congested specimens they are likely to be shorter and stouter, or even a little curved. Not infrequently straight spines become somewhat curved from the plant's being dried under pressure. The spines shown in this figure are similar to those of *O. jenmani*, but the leaf segments are very different from those of that species.

The Linnæan species name *aculeatum*, published under *Adiantum*, has been applied very generally to two distinct species of this alliance and might with almost equally good reason be applied to a third. It was published originally with reference to three plates, mentioned in the following order: (1) Plumier's plate 94, representing a plant from the island of Santo Domingo; (2) Petiver's plate 11, figure 6, which is a copy of the former; (3) Sloane's plate 61, representing a Jamaican plant which subsequently was described by Swartz under the name *fumarioides*, which it has since retained and ought to retain. From the historical standpoint, therefore, as well as from the order of citation, the name *aculeatum* should be associated with the Santo Domingo plant. In some way, probably because the several species have not been very carefully collected or studied closely, the name *aculeatum* has been applied not only to the Santo Domingo plant, but also to a related Jamaican species which is not that figured by Sloane in plate 61. This Jamaican plant is well described by Jenman, and is amply distinguished from the true *O. aculeata* of Santo Domingo, eastern Cuba, and Porto Rico, by its simpler and coarser pinnules and by the character of its spines, these being short, stout, and retrorse in the Jamaican plant, whereas they are long, acicular, and spreading in true *aculeata*. Jenman's characterization is so excellent that there is good reason for dedicating this excellent species to him.

As to the Jamaican plant of Sloane, we have not only Sloane's plate (*pl. 61*), but also Jenman's testimony¹ that Sloane's specimen in the British Museum is the species known properly as *O. fumarioides*.

There exists among individuals of *O. aculeata* a great deal of variation in the degree of dissection, differences which apparently are due to habitat and altitude and partly to geographic considerations. Other factors which to an unusual extent affect the form of the individual are the age of the plant, the degree of fertility, and the seasonal condition of the plant when collected. Judging from the series at hand this species reaches its best development in eastern Cuba at about 600 meters elevation. The stout congested form shown in Plumier's plant is found in very few plants.

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

SANTO DOMINGO: Without locality, *Wright, Parry & Brummel* 33. Near Constanza, alt. 1,190 meters, *von Türckheim* 2995.

CUBA: Lower open slopes of Gran Piedra, Oriente, alt. 500 meters, *Maxon* 4090a. Upper slopes and summit of Gran Piedra, alt. 900 to 1,200 meters, *Maxon* 4073; *Shafer* 9066. Santa Ana, near Jaguey, Oriente, on steep banks in the open, *Maxon* 4131. Cooper's Ranch, base of El Yunque, near Barucoa, *Underwood & Earle* 817. Slopes and summit of El Yunque, alt. 300 to 600 meters, *Pollard & Palmer* 170. Loma Menquara, Oriente, alt. 680 to 1,000 meters, *Shafer* 3833. Alluvial valley of Rio Yamanigüey, Oriente, *Shafer* 4197. Without locality, *Wright* 960.

PORTO RICO: Near Rio Piedras, alt. 60 meters, *Hioram* 108; *Mr. & Mrs. A. A. Heller* 126. Near Mayaguez, alt. 120 meters, *Britton & Marble* 505; *Heller* (without number). Near Utuado, *Underwood & Griggs* 25; *Britton & Marble* 1074. Beatriz de Caguas, *Goll* 402, 403, 433. Maricao, *Sintenis* 169. Cayey, *Sintenis* 2172 (in part). Without locality, *Fisher* 71.

CULTIVATED SPECIMENS: Ex. herb. Hort. Bot. Lips. (as *Microlepia aculeata*).

3. *Odontosoria jenmanii* Maxon, sp. nov.

PLATE 2.

"*Davallia aculeata*" Jenman, Bull. Bot. Dept. Jamaica I. 23: 6. 1891 (excluding reference to Plum. *pl. 94* and Hook. *pl. 54. B*), not *Adiantum aculeatum* L. in any part.

Fronds distichous, ascending, scandent, 2 to 6 meters long, intricate; rhizome slender, terete, wide-creeping, freely branched, densely clothed with lance-attenuate imbricate bright brown scales; lamina greatly elongate, quadripinnate throughout;

¹ Journ. Bot. Brit. & For. 24: 41. 1886.



ODONTOSORIA JENMANII MAXON.

primary rachis stout (3 to 3.5 mm. in diameter), castaneous, subterete, only the upper side flattish (with a low marginal ridge at each side), the under parts beset with numerous short stout conical spines less than 1 mm. long; primary pinnæ opposite, deltoid, 30 to 50 cm. long, 20 to 35 cm. broad, comprising about 4 to 8 pairs of spreading subopposite secondary pinnæ below the acuminate apex, the secondary rachis similar to the primary, but sharply flexuous at the insertion of the secondary pinnæ, strongly aculeate below, the spines stout, conical, retrorse, 1 to 2 mm. long; secondary pinnæ similar to the primary, the basal pair distant, reduced, subaxillary, the larger ones (2 to 4 pairs) imbricate, deltoid, 10 to 18 cm. long, 7 to 14 cm. broad, spreading or reflexed, the tertiary rachises regularly flexuose, retrorsely aculeate below; pinnules of the third order 6 to 10 pairs below the gradually acuminate pinnate apex, the basal ones reduced, distant, subaxillary, the larger ones apart or contiguous, oblong-lanceolate from an unequal base, the quaternary rachises sinuous or subflexuous, smooth or obscurely aculeolate; pinnules of the fourth order numerous, sessile or minutely stalked, rhombic to irregularly obcordate, simple or the larger ones with 1 or 2 large free obcordate lateral segments, the terminal segment subrhombic, irregularly 1 or 2-lobed; sori several to each lobe, small, endophyllous, the involucre narrowly obconical, open only at the margin. Leaf tissue thick, spongiöse-herbaceous or subcoriaceous, the veins concealed or nearly so.

Type in the U. S. National Herbarium, nos. 427877-879, comprising three separate primary pinnæ taken from a plant growing on a bank in partial shade near Cinchona, Jamaica, altitude about 1,500 meters, April 25, 1903, by William R. Maxon (no. 1594).

The confusion of this species with the very different true *aculeata* from Cuba, Santo Domingo, and Porto Rico, has already been mentioned under the last preceding species, and the main points of difference have been enumerated. Jenman's description is inaccurate in one respect: The sori are not, as a rule, solitary upon the ultimate divisions, but occur usually in 2's or 3's at the ends of the 2 or 3 ultimate veinlets. Plumier's plate 94 cited by Jenman represents true *O. aculeata*. Hooker's plate 54, B, also cited by him, undoubtedly illustrates the Lesser Antilles plant here treated as *O. flexuosa*, the figure having been drawn probably from a Dominica specimen.

Jenman's comment upon this species is as follows: "Abundant in forests and their skirts, forming dense and impenetrable thickets from 2,500 ft. altitude up to the highest ridges and peaks. The fronds reach 15 or 20 ft. high, supported by each other or the surrounding bushes or trees, the lower pinnæ dying and decaying away as the top of the frond extends. Cutting through a thicket, it emits a very offensive smell; the juice produces a yellowish stain or dye."

Besides the type specimens the following are in the U. S. National Herbarium:

JAMAICA: Vicinity of Cinchona, alt. 1,500 meters, *Underwood* 465, 3123; *Clute* 102. Slopes above Tweedside, alt. 600 to 900 meters, *Maxon* 932a. Without definite locality, *Harris* 7428; *Hart* 348.

EXPLANATION OF PLATE 2.—Portion of the type specimen of *Odontosoria jenmanii*, showing the primary axis, the point of origin of the opposite primary pinnæ, and the first large pair of secondary pinnæ (the upper one almost completely). Natural size.

4. *Odontosoria flexuosa* (Spreng.) Maxon.

Davallia flexuosa Spreng.; Kunze, Bot. Zeit. 8: 213. 1850.

Microlepidia flexuosa Ettingsh. Farnkr. 208. 1865.

TYPE LOCALITY: Martinique (*Sieber* 23).

DISTRIBUTION: Known only from Martinique, Guadeloupe, and Dominica, ascending to 580 meters.

ILLUSTRATIONS: Hook. Sp. Fil. 1: pl. 54. B (as *Davallia aculeata*); Fée, Gen. Fil. pl. 27 B. f. 2 (as *Stenoloma dumosum*); Ettingsh. loc. cit. pl. 138. f. 4. pl. 140. f. 5. (as *Microlepidia flexuosa*).

This, the only member of *Odontosoria* known from the Lesser Antilles, was first given a name by Sprengel, which, though early mentioned in print,¹ was not associated

¹ Presl, Tent. Pter. 129. 1836, name only.

with a diagnosis until 1850, when Kunze described the species briefly but accurately, basing his diagnosis wholly upon the Martinique plant (Sieber, Fl. Martin. Suppl. no. 23) cited by Presl, as represented in the Berlin herbarium. Kunze refers here also two specimens from Santo Domingo: (1) A plant communicated by Mertens as *Davallia dumosa*, and (2) a specimen mentioned and figured by Sprengel in 1804¹ as *Adiantum aculeatum*. The former specimen has not been seen by the writer, but presumably it is like the latter, which, as figured by Sprengel, is certainly a form of true *Odontosoria aculeata* having the spines somewhat curved.

In addition to the peculiar shape of the segments, *Odontosoria flexuosa* is well distinguished by the unusual character of its rachises. The primary rachis, which is of a rich purplish castaneous color, is flattish above, with a strong and rather sharp marginal ridge at either side. On the lower side it is more or less acutely angled, the rachis thus in cross section rather strongly trigonous, as shown in Fée's illustration cited above. Strangely enough the secondary and tertiary rachises are not at all flexuose, as in other species of the genus, and usually the primary rachis also is straight. In the lower (older) parts, however, the primary rachis is sometimes sinuously flexuose, though not in the sense of "zigzag," as the term flexuose is commonly employed. Sprengel's name *flexuosa*, therefore, is not only relatively inappropriate but actually so, and we can only conjecture that besides Sieber's Martinique plant there were other elements (specifically different and from other regions, with zigzag rachises) included by Sprengel under that name. The actual type of *flexuosa*, nevertheless, is clearly Sieber's no. 23, since Kunze expressly states that this served for his diagnosis.²

Hooker's treatment of this group is very largely incorrect. The species figured by him as *Davallia aculeata* is certainly *O. flexuosa*, the illustration presumably being drawn from a Dominica plant collected by Imray (no. 7), cited by Hooker.

The material of *O. flexuosa* in the U. S. National Herbarium, cited below, is very complete and admits of no doubt as to the specific distinctness of the Lesser Antilles plant.

MARTINIQUE: Route du Morne-Rouge à Calabasse, alt. 580 meters, *Duss* 1682.

GUADELOUPE: Without definite locality, *Duss* 4238 (4 sheets).

DOMINICA: Laudat, *Lloyd* 115 (2 sheets). Without definite locality, *Eggers*.

5. *Odontosoria wrightiana* Maxon, sp. nov.

PLATE 3.

Plants of comparatively small size in all parts, the fronds ascending, scandent, 0.6 to 2 meters long. Rhizome slender (2 to 2.5 mm. in diameter), woody, creeping, branched, tortuous, densely invested with acicular golden brown scales; lamina quadripinnate, in young specimens deltoid, in mature ones greatly elongate, oblong to linear-oblong; primary rachis slender (1.5 to 2 mm. in diameter), dark reddish, subterete, only the upper surface flattish (with a slender marginal ridge at each side), the sides and under part beset with numerous acicular straight spreading spines 2 to 3.5 mm. long; primary pinnæ of mature specimens opposite, 8 to 11 cm. apart, deltoid to ovate, 15 to 20 cm. long, 8 to 13 cm. broad, spreading, the secondary rachis strongly flexuose, reddish to stramineous, bearing numerous straight spreading acicular spines up to 4 mm. long; secondary pinnæ subopposite to alternate, deltoid to deltoid-oblong, the larger ones (5 or 6 pairs) 3.5 to 7 cm. long, 2 to 6 cm. broad, adjacent or somewhat apart, spreading, the tertiary rachises very slender, strongly flexuose, bearing numerous very slender acicular spines up to 3.5 mm. long; pinnules of the third order similar in shape to the secondary pinnæ, the basal ones sometimes not reduced, the larger ones (5 to 7 pairs below the acutish apex) adjacent or somewhat apart, alternate, their slender rachises unarmed or sparingly spiny; pinnules of the fourth order 2 to 4 pairs, alternate, the larger ones comprising 1 or 2 unequally stalked cuneate divisions, each

¹ Anleit. Gewächs. 3: 150. pl. 5. f. 37. 1804.

² A photograph and a fragment of this specimen, recently received through the kindness of Dr. I. Urban, accord perfectly with the other material studied and here cited.



ODONTOSORIA WRIGHTIANA MAXON.

of these cleft or divided nearly to the base into 2 slender ultimate segments, these thus nearly free or acutely joined in pairs, linear or slightly clavate, 1.5 to 4 mm. long, mostly 0.5 mm. or less broad; veins solitary in each division, or, if 2, each extending to a separate marginal lobe; sori solitary, each completely terminating a division or lobe, the indusium transversely oblong or oval, more delicate than the opposed leaf portion, whitish, partially free at each side. Leaf tissue rigidly herbaceous, the veins slightly elevated.

Type in the U. S. National Herbarium, no. 372179, collected in an open bushy ravine near Pinar del Rio, province of Pinar del Rio, Cuba, February 22, 1900, by William Palmer and J. H. Riley (no. 42).

This form has been referred sometimes to *O. fumaroides*, with which species it has no near relationship whatever. In its armature it is not unlike true *O. aculeata*, as here defined, and notwithstanding its remarkably fine-cut foliage it is in other respects clearly allied to that species. It is one of the smallest members of the genus.

The following material is in the U. S. National Herbarium:

CUBA: Without locality, *Wright* 898, 1804. *Herradura*, *Van Hermann* 760; *Baker* 2074; *Britton & Earle* 6589. Near El Guama, in small ravine of exposed mountain slope, *Palmer & Riley* 214. *Consolacion del Sur*, *Palmer & Riley* 469. *Sierra de Cobra*, on Guane Road, bank of stream, *Britton*, *Britton & Gager* 7187. (All but the first in the province Pinar del Rio.)

ISLE OF PINES: Near Nueva Gerona, flat ground among bushes, July 3, 1900, *Palmer & Riley* 984. Same locality, on exposed stream bank, July 7, 1900, *Palmer & Riley* 1022. Same locality, *Curtiss* 362. Without locality, *A. A. Taylor* 5.

EXPLANATION OF PLATE 3.—Portion of the type specimen of *Odontosoria wrightiana*, showing the primary axis and one of a pair of opposite primary pinnae. Natural size.

6. *Odontosoria colombiana* Maxon, sp. nov.

Lamina not very ample, about 60 to 70 cm. broad, quadripinnate, the primary rachis castaneous, 2 to 2.5 mm. in diameter, subterete (only the upper face flattish, with a relatively heavy marginal ridge at each side), slightly muricate from the presence of a few minute scattering conical spines upon all sides, these about 0.5 mm. long; primary pinnae opposite, 30 to 40 cm. long, 10 to 20 cm. broad, oblong to narrowly ovate, the secondary rachis strongly flexuous, bearing a few narrowly conical hooked retrorse spines, 1 mm. long, or less; secondary pinnae (larger ones) about 10 or 12 pairs, alternate, strongly retrorse, approximate or distant, ovate to deltoid-oblong, 5 to 10 cm. long, 2.5 to 5 cm. broad, the tertiary rachises strongly flexuous, sparingly aculeolate below; pinnules of the third order ovate to deltoid-oblong, the larger ones (6 to 9 pairs) 1 to 2.5 cm. long, 0.5 to 1.3 cm. broad, alternate, retrorse-spreading, their rachises greenish-marginate, slender (0.3 to 0.4 mm. broad), flexuous; pinnules of the fourth order alternate, 3 to 7 pairs, variable in outline, the larger (basal and middle) ones consisting of 2 or 3 alternate stalked divisions, these usually once dichotomous, the segments divaricate, linear, 1.5 to 3 mm. long, 0.2 to 0.5 mm. broad, not broader than the slender similarly foliaceous stalks except at the slightly clavate apices; sori solitary, each terminating a segment, the indusium broadly triangular, nearly as broad as the scarcely modified opposed terminal portion of the segment, partially free at each side. Leaf tissue dark green, delicately herbaceous.

Type in the U. S. National Herbarium, no. 826368, collected near Amalfi, province of Antioquia, Colombia, altitude about 2,000 meters, September, 1884, by F. C. Lehmann (no. XXXIV).

In the shape and size of the ultimate segments the resemblance of this species to *O. schlehtendahlia* is so great that a specimen of the above collection (Lehmann XXXIV) was so determined by Hieronymus.¹ But *O. schlehtendahlia* is entirely unarmed in

¹ Bot. Jahrb. Engler 34: 454. 1905.

all its parts, the rachises are less decidedly flexuose, and the secondary pinnæ and the pinnules are not sharply retrorse as in *O. colombiana*. The New Grenada plants cited by Mettenius¹ as *Lindsaya fumarioides* may possibly be of this species.

7. *Odontosoria fumarioides* (Swartz) J. Smith, Hist. Fil. 264. 1875. PLATE 4.
Adiantum aculeatum L. Sp. Pl. 1096. 1753, in part, as to Jamaican plant figured by Sloane.

Acrostichum aculeatum L. Syst. Nat. ed. 10. 2: 1320. 1759.

Davallia fumarioides Swartz, Journ. Bot. Schrad. 1800²: 89. 1801.

Trichomanes fumarioides Poir. in Lam. Encycl. 8: 82. 1808.

Stenoloma fumarioides Fée, Gen. Fil. 330. 1852.

? *Lindsaya fumarioides* Mett. Ann. Sci. Nat. V. Bot. 2: 217. 1864.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Restricted to Jamaica, ascending from the lowlands to 750 meters or rarely to 1,000 meters elevation.

ILLUSTRATIONS: Sloane, Voy. Jam. 1: pl. 61; Hedw. Fil. Gen. Sp. [pl. 20,] (as *Davallia aculeata*).

As explained under *Odontosoria aculeata*, plate 61 of Sloane, representing a Jamaican plant, formed the lesser part of the Linnæan *Adiantum aculeatum*; and a Jamaican specimen of this same species, received from Swartz, was figured as *Davallia aculeata* by Hedwig in 1799. Two years later, however, Swartz distinguished the Jamaican plant as a new species, *Davallia fumarioides*. That he had not fully solved the problem is evident from his treatment in the Synopsis Filicum (1806), for he there recognizes three species: (1) *D. aculeata* of Jamaica and Santo Domingo, with citation of Sloane's plate 61; (2) *D. dumosa*, a new species from Santo Domingo, with citation of Plumier's plate 94; and (3) *D. fumarioides*, from Jamaica, with citation of Hedwig's plate [20]. The new species, *dumosa*, is thus a synonym of true *aculeata*, if *aculeata* be typified upon Sloane's plate 94, as seems proper. Sloane's plate 61 is certainly misunderstood by Swartz, however, for it represents exactly the species illustrated by Hedwig and named by Swartz *D. fumarioides*. What Jamaican plant Swartz may have had in hand as *D. aculeata* in 1806 is uncertain; but it may have been that here described as *Odontosoria jenmanii*, a species not represented by any of the figures cited and until the present time never given a valid name. With ample material there can be no possible confusion of these species; the only difficulty is found in explaining briefly the historical errors due to scanty material, misidentification of the plates, and a consequent misapplication of the species names.

Odontosoria fumarioides is a very common species in Jamaica. Jenman's comment² is as follows:

"Abundant among the lower hills on the skirts of woodland, among bushes, in hill-side pastures, and by open pathways, but not forming such dense thickets as the preceding [*O. jenmanii*], of which it is the lowland analogue, ascending only to about 2,500 ft. altitude, where that first appears. The two species hardly touch in their range."

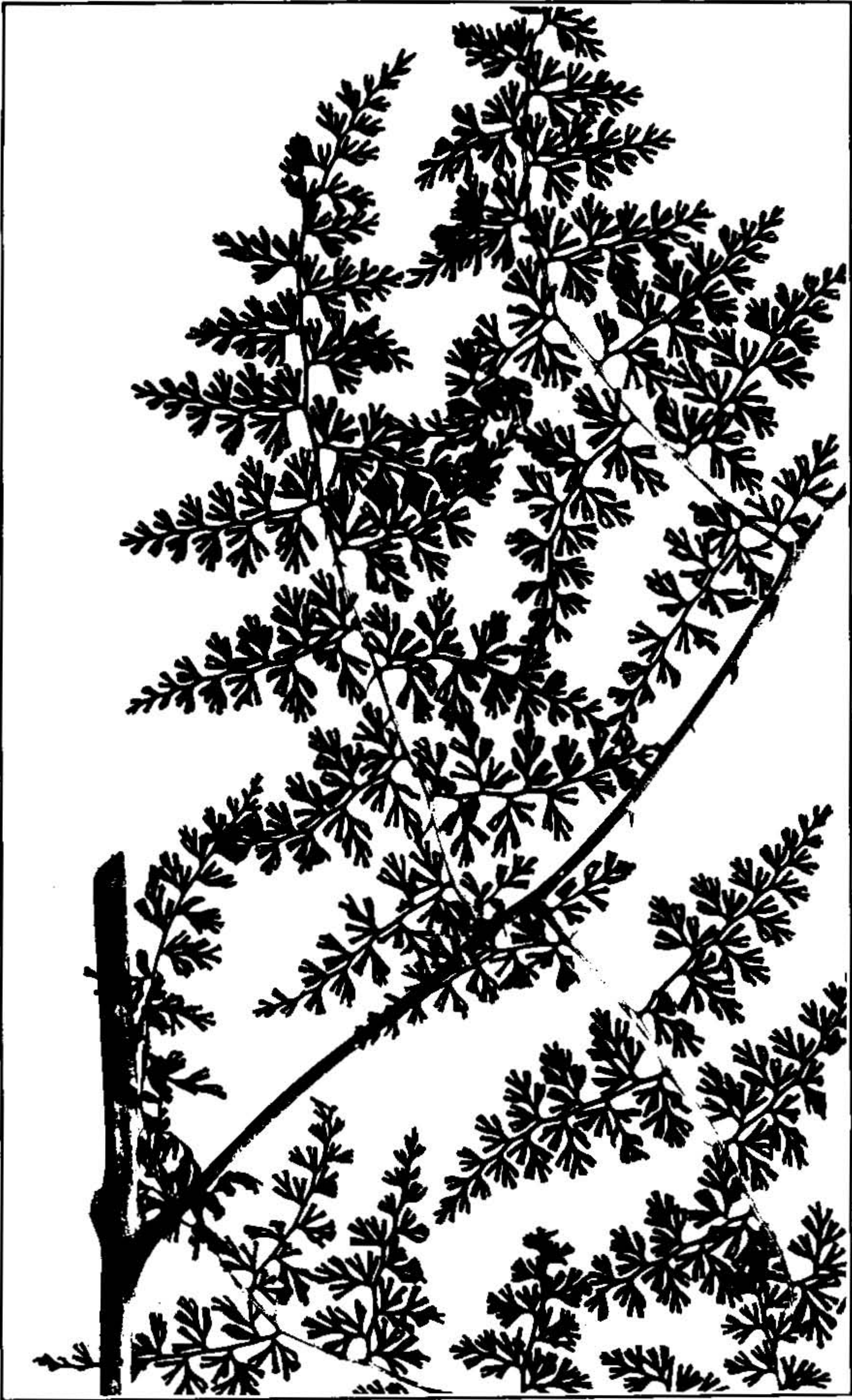
The remarkably thin texture and narrow, deeply cut segments readily distinguish this from *O. jenmanii*, the only other Jamaican species. It is more closely allied to the Costa Rican *O. gymnogrammoides*.

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

JAMAICA: Slopes above Ginger River (above Castleton), alt. 250 meters, climbing over bushes, Maxon 848. Trail from Bath to Cuna Cuna Pass, alt. 300 to 600 meters, Maxon, 1709, 1727. Vicinity of Hollymount, Mount Diabolo, alt. 750 meters, on open deforested bushy slopes, Maxon 2292. Mansfield, near

¹ Ann. Sci. Nat. V. Bot. 2: 217. 1864.

² Bull. Bot. Dept. Jamaica I. 23: 6, 7. 1891.



ODONTOSORIA FUMARIOIDES (SWARTZ) J. SMITH.



ODONTOSORIA GYMNOGRAMMOIDES CHRIST.

Bath, alt. 300 to 500 meters, *Maxon*. Above Gordontown, on dryish banks, *Maxon* 2804. Crown lands 4 miles west of Troy, alt. 750 meters, *Maxon* 2873. Near Troy, alt. 450 to 660 meters, *Underwood* 2925. Bull Head Mountain, *Underwood* 3357. Old England, alt. 1,000 meters, *Harris*. Cedar Valley, alt. 600 meters, *Clute* 156. Near Port Antonio, *Fredholm* 3231 (distributed as *Davallia aculeata*). Without locality, *Hart* 326.

EXPLANATION OF PLATE 4.—A characteristic section of *Odontosoria fumaroides*, showing the primary axis and the basal portion of one of the primary pinnæ; specimen from Hollymount, Mount Diabolo, Jamaica, alt. 750 meters, *Maxon* 2292. Natural size.

8. *Odontosoria gymnogrammoides* Christ, Bull. Soc. Bot. Genève II. 1: 228. 1909. PLATE 5.

TYPE LOCALITY: Estrella, province of Cartago, Costa Rica (*Cooper*).

DISTRIBUTION: Confined to the interior mountain region of Costa Rica, at 1,400 to 1,800 meters elevation.

The type collection of this species has not been seen by the writer. Agreeing with the description, however, are Costa Rican specimens, collected by the writer and cited by Doctor Christ. The species has some resemblance to *O. fumaroides* of Jamaica in cut of leaf and particularly in texture.

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

COSTA RICA: Estrella, province of Cartago, alt. 1,320 meters, *Cooper* (*J. D. Smith* 6015), the type collection. Without definite locality, *Cooper*; *A. de Zeledon*. Forests of Juan Viñas, *Pittier* (?) 10142. Volcano Turrialba, *Ridgway*. Near Pacayas, lower slopes of Volcano Turrialba, *Maxon* 350. Vicinity of La Palma, alt. 1,450 to 1,550 meters, *Maxon* 461. San Jeronimo, alt. 1,500 meters, *Wercklé*. Banks of the Rio Las Vueltas, Tucurrique, alt. 635 meters, *Tonduz* 12796. Santiago, near San Ramon, alt. 1,200 to 1,300 meters, *Brenes* 14207.

EXPLANATION OF PLATE 5.—A characteristic section of *Odontosoria gymnogrammoides*, showing the primary axis and the basal portion of one of the primary pinnæ; specimen from vicinity of Pacayas, Costa Rica, *Maxon* 350. Natural size.

9. *Odontosoria schlechtendahlia* (Presl) C. Chr. Ind. Fil. 209. 1905.

Davallia divaricata Schlecht. & Cham. Linnaea 5: 617. 1830, not Blume, 1828.

Davallia schlechtendahlia Presl, Tent. Pter. 129. 1836.

Stenoloma schlechtendahlia Fée, Gen. Fil. 330. 1852.

Microlepis schlechtendahlia Mett. Fil. Hort. Lips. 104. 1856.

Odontoloma schlechtendahlia Fourn. Mex. Pl. 132. 1872.

Odontosoria divaricata J. Smith, Hist. Fil. 264. 1875.

Lindsayopsis divaricata Kuhn, Gruppe Chaetop. 27. 1882.

Lindsaya schlechtendahlia Christ, Farnkr. Erde 296. 1897.

TYPE LOCALITY: Mexico.

DISTRIBUTION: Humid regions of eastern and southern Mexico, Guatemala, and British Honduras, ascending to 1,000 meters.

ILLUSTRATIONS: Fée, loc. cit. pl. 27 bis. A. f. 1; Hook. Sp. Fil. 1: pl. 54. C.

As noted above in the discussion of this genus as here restricted, the present species is wrongly placed by Diels with those species of small size and erect determinate growth, which properly constitute a separate genus, *Sphenomeris*. Nor is there warrant for using the name *divaricata* for this plant, since Schlechtendahl's publication of it is antedated two years by that of Blume.

Odontosoria schlechtendahlia finds its nearest ally in *O. guatemalensis* and is like that species in being wholly unarmed throughout.

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

MEXICO: District of Cordoba, Vera Cruz, *Fink* 105. Barrio Nuevo, Orizaba, *Rovirosa* 78. La Soledad, alt. 1,000 meters, *Langlassé* 976. Puebla, *Arsène*.

GUATEMALA: Choctum, *Salvin*.

BRITISH HONDURAS: Without locality, *Blancenaux*.

10. *Odontosoria guatemalensis* Christ, Bull. Soc. Bot. Genève II. 1: 229. 1909.

TYPE LOCALITY: Cuesta Grande, Hacienda de las Nubes, Guatemala (*Bernoulli & Cario* 402).

DISTRIBUTION: Apparently confined to western Guatemala, ascending to 1,800 meters.

This species, of which a few words of description were published by Doctor Christ in 1909, is one of marked peculiarity. Superficially it resembles the Jamaican *O. fumaroides*, but it is devoid of spines throughout and the ultimate divisions are smaller, shorter, and less divaricate. The nearly terete, highly polished, unarmed, castaneous rachises also are characteristic.

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

GUATEMALA: PIRENEOS, above San Felipe, alt. 1,200 to 1,500 meters, *Maxon & Hay* 3567. Santa Maria (lower slopes of the Volcan de Agua), alt. 1,500 to 1,800 meters, *Kellerman* 5586.

DOUBTFUL SPECIES.

1. *PROSOPTIA BIPINNATA* Presl, Tent. Pter. 116. pl. 6. f. 19. 1836 (name only).

Beyond the poor figure and the statement of the West Indies as type locality, there is apparently no means of identifying this species, which technically must be regarded as unpublished. It is referred doubtfully to *uncinella* by Mettenius, and to the same species by Christensen without reservation. The original specimen may be in Presl's herbarium at Prague.

2. *ODONTOSORIA SCANDENS* (Desv.) C. Chr. Ind. Fil. 354. 1905.

Humata scandens Desv. Mém. Soc. Linn. Paris 6: 324. 1827.

Davallia scandens Moore, Ind. Fil. 299. 1861, not Swartz, 1801.

Lindsayopsis scandens Kuhn, Gruppe Chaetop. 27. 1882.

The original description is as follows:

Frondeb. scandentibus, tripinnatis, subaculeatis; pinnis oppositis distantibus; pinnulis infimis 2-4-pinnatis extimis cuneato-rhomboides, lobatisque; pinnellis subdecurrentibus, basi cuneatis, apice oblique bilobis; soris in margine incrassato affixis. Crescit in fruticetis peruvianis. Rachis funiculosa glabra, subquadrangularis.

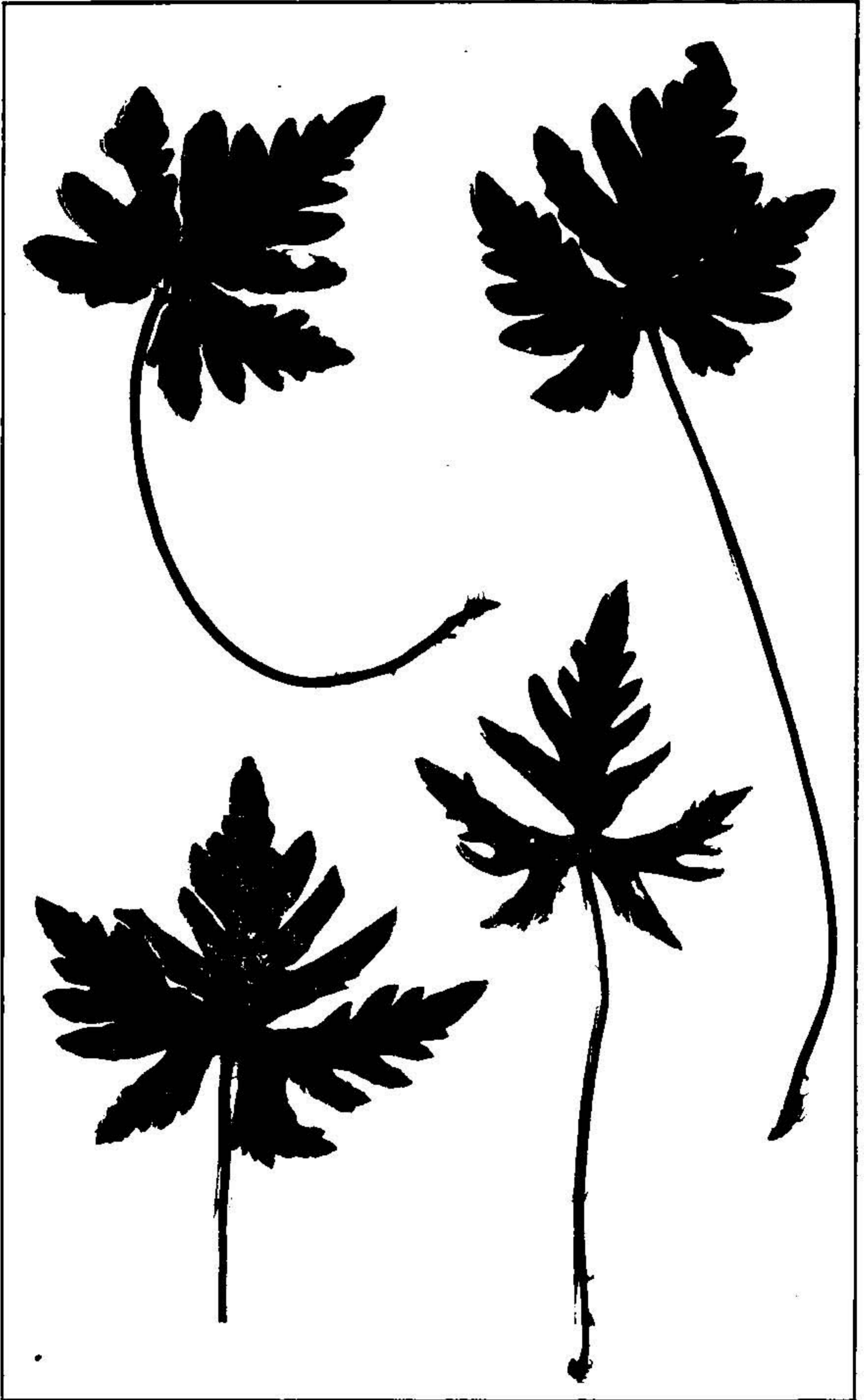
There is at hand no material of this species, which appears to be known only from Peru. It was apparently studied by Kuhn, since it is one of the three species listed by him under *Lindsayopsis*, in his paper upon this group. By Christensen it is regarded as possibly identical with *O. uncinella*, although the description points to a plant very different from that species.

3. *DAVALLIA MITIS* Kunze, Bot. Zeit. 8: 214. 1850.

This, which is one of the species described by Kunze in his critical comments upon Hooker's treatment of the group in the first volume of the *Species Filicum*, is listed by Christensen (under *Davallia*) as an unidentified or doubtful member of *Odontosoria*. The type is a Guiana specimen collected by Poiteau and presented to Kunze by Bory.

NOTES UPON *BOMMERIA* AND RELATED GENERA.*BOMMERIA*.

Among the many interesting ferns collected in eastern Mexico by Dr. C. A. Purpus within recent years is the following species, hitherto undescribed. Superficially it bears a certain resemblance to *Bommeria hispida* (*Gymnogramme hispida* Mett.) but differs somewhat in leaf form and very conspicuously in its areolate venation, *B. hispida* being free-veined throughout.



BOMMERIA SUBPALEACEA MAXON.

Bommeria subpaleacea Maxon, sp. nov.

PLATE 6.

Rhizome slender (about 2 mm. in diameter), creeping, closely covered with appressed rigid lance-acicular imbricate light brown scales (about 2 mm. long) with a blackish median stripe; fronds subfasciculate, apparently distichous, 8 to 13 cm. long; stipe 6 to 11 cm. long, straight or subflexuous, usually arcuate toward the base, stout (about 1 mm. thick), dark brown, at first densely and closely short-pilose, soon glabrescent and lustrous, toward the base bearing a few triangular-lanceolate to ovate, flattish, somewhat flaccid scales, these concolorous or with a narrow darker median stripe, minutely erose-denticulate; lamina 3 to 5.5 cm. long, 3 to 6 cm. broad, deltoid-cordate, subpentagonal, bipinnately parted at the base, the basal pinnules deltoid, inequilateral, strongly basisopic, coarsely and obliquely pinnatifid, having the inferior basal lobe crenately lobed upon the proximal margin; middle (terminal) portion of the lamina equilateral, acute or acuminate, deeply, regularly, and obliquely pinnatifid, the segments (about 3 pairs) approximate, linear-oblong to oblong, simple and entire, or the larger ones crenate; leaf surfaces densely strigose, the midveins sparingly clothed below with brownish concolorous ovate flaccid scales, these flattish and subimbricate; venation almost wholly areolate, the costal areoles elongate, horizontal, 5 to 7 mm. long, the others very much smaller, oblique, extending in 2 or 3 irregular rows nearly to the margin, the ultimate (marginal) veinlets obscure, mostly free; sporangia borne upon all of the veins excepting most of the larger costal areoles, forming a conspicuous very broad marginal band.

Type in the U. S. National Herbarium, no. 841463, collected in some part of the Province of Puebla, Mexico, during August, 1909, by Dr. C. A. Purpus (no. 4025). No other specimens have been seen.

EXPLANATION OF PLATE 6.—Type specimens of *Bommeria subpaleacea*. Natural size.

The present description adds a fourth member to the small group of species recognized by Underwood¹ under the name of *Bommeria*, a genus first proposed by Fournier² in 1870. Of the species known previously, two, *Bommeria pedata* and *B. hispida*, are completely free-veined; while the third, *B. ehrenbergiana*, which is the type of the genus, has areolate venation similar to that of *B. subpaleacea*. In habit and particularly in their silky-strigose, pedate leaves and mostly slender, creeping rootstocks, all four species are much alike and they are unquestionably to be associated as a group, whatever its relative rank. They may be distinguished readily as follows:

KEY TO THE SPECIES.

Venation almost wholly areolate.

Lamina 10 to 12 cm. long and broad, scantily short-strigose above, long-pilose below; sporangia confined to the outer areoles and free marginal veinlets, forming a comparatively narrow marginal band..... 1. *B. ehrenbergiana*.

Lamina 3 to 6 cm. long and broad, densely strigose upon both surfaces; sporangia borne upon all the veins, excepting only a part of the costal areoles..... 2. *B. subpaleacea*.

Venation wholly free.

Plants relatively small, the lamina usually about 5 or 6 cm. (casually 9 cm.) broad and long, the pinnæ and segments obtuse, rounded; leaf surfaces densely strigose above, below tomentose with stiff hairs intermixed... 3. *B. hispida*.

Plants much larger, the lamina usually 10 to 15 cm. broad and long, the pinnæ and large segments sharply acute or long-acuminate; leaf surfaces scantily strigose above, below densely pilose, the hairs unequal and spreading..... 4. *B. pedata*.

¹ Bull. Torrey Club 29: 633. 1902.

² Fourn. in Baill. Dict. Bot. 1: 448. 1876.

Of these the three species earlier described have been so generally misunderstood or confused with each other that further notes may be of value.

1. *Bommeria ehrenbergiana* (Klotzsch) Underw. Bull. Torrey Club 29: 633. 1902.

Gymnogramme ehrenbergiana Klotzsch, Linnaea 20: 411. 1847.

Gymnogramme podophylla Hook. Sp. Fil. 5: 152. 1864.

Stegnogramme ehrenbergiana Fourn. Mex. Pl. 1: 71. 1872.

Hemionitis podophylla J. Smith, Hist. Fil. 150. 1875.

Dictyogramme podophylla Trev. Atti Ist. Veneto V. 3: 591. 1877.

Bommeria podophylla Fourn. Bull. Soc. Bot. France 27: 328. 1880.

TYPE LOCALITY: "Ad thermas prope Grande, in regno mexicano" (*Ehrenberg* 662).

DISTRIBUTION: Probably confined to Mexico, though reported also from Guatemala.

ILLUSTRATION: Hook. loc. cit. pl. 296 (as *Gymnogramme podophylla*).

This species appears to be rare in collections. Klotzsch had but a single collection; Hooker had only Müller's plant (no. 719), beside Wright's Boundary Survey specimens (which are *B. hispida*); Underwood cites only a single collection; and there is in the National Herbarium but one specimen, this collected upon Orizaba in July, 1891, by Henry E. Seaton (no. 492), distributed as *Gymnogramme podophylla*.

2. *Bommeria subpaleacea* Maxon, Contr. U. S. Nat. Herb. 17: 169. 1913.

TYPE LOCALITY: Province of Pueblo, Mexico.

DISTRIBUTION: Known only from the type collection (*Purpus* 4025).

ILLUSTRATION: Contr. U. S. Nat. Herb. 17: pl. 6.

3. *Bommeria hispida* (Mett.) Underw. Bull. Torrey Club 29: 633. 1902.

Gymnogramme hispida Mett.; Kuhn, Linnaea 36: 72. 1869.

Bommeria schaffneri Fourn. Bull. Soc. Bot. France 27: 327. 1880.

Gymnogramme schaffneri Baker, Ann. Bot. 5: 484. 1891, not Moore, 1861.

Neurogramme hispida Diels in Engl. & Prantl, Pflanzenfam. 14: 264. 1899.

Gymnopteris hispida Underw. Native Ferns ed. 6. 84. 1900.

TYPE LOCALITY: "Pass of the Limpia, [Texas,] crevices of rocks on the mountains" (*Wright* 819).

DISTRIBUTION: Western Texas to southern California; also common in Mexico.

This species shows wide variation in leaf shape and size. The most peculiar state is that represented by Pringle's 4420, which is the type of his variety *muralis*, a form which owes its reduced stature possibly to an unfavorable habitat upon the face of cliffs; some of the fronds, though less than 1 cm. wide, are yet perfectly fertile.

Besides the type collection of *Bommeria hispida* the following specimens are in the U. S. National Herbarium:

TEXAS: Limpio Mountains, July, 1883, *V. Havard*.

NEW MEXICO: Bear Mountains, November, 1886, *Rusby*. Organ Mountains, Dona Ana County, alt. 1,650 meters, *Wootton* 105; also other specimens. Guadalupe Canyon, at Mexican boundary line, *Mearns* 695.

ARIZONA: Lowell, May, 1884, *W. F. Parish*. Nogales, *William Palmer* 1204; *Evermann*. Bowie, *Jones* 4254. Baboquivari Mountains, April 6, 1884, *Pringle*. Chiricahua Mountains, *Rothrock* 513; *Blumer* 1962. Huachuca Mountains, August-October, 1882, *Lemmon*. Rincon Mountains, north slope, *Blumer* 3294. Santa Catalina Mountains, March, 1881, *G. R. Vasey*. Santa Rita Mountains, *Griffiths* 6055.

CALIFORNIA: Without locality, *E. Palmer*.

MEXICO: Fronteras, Sonora, alt. 1,400 meters, *Hartman* 29. Huchuerachi, Sonora, *Lloyd* 482. San Luis Potosí, alt. 1,800 to 2,100 meters, *Parry & Palmer* 1006. Valley of Mexico, *Schaffner* 32. Cliffs near Tequila, Jalisco, *Pringle* 4420. Rocky hills, Sandia Station, alt. 2,100 meters, *Pringle* 10151. Durango and vicinity, 1896, *E. Palmer* 556. Otinapa, Durango, 1906, *E. Palmer* 358.

4. *Bommeria pedata* (Swartz) Fourn. Bull. Soc. Bot. France 27: 327. 1880.*Hemionitis pedata* Swartz, Syn. Fil. 20, 209. 1806.*Gymnogramma pedatum* Kaulf. Enum. Fil. 69. 1824.*Neurogramme pedata* Link, Fil. Hort. Berol. 139. 1841.*Gymnopteris pedata* C. Chr. Ind. Fil. 341. 1905.

TYPE LOCALITY: Not stated, but presumably Mexico.

DISTRIBUTION: Mexico and Guatemala.

ILLUSTRATION: Swartz, loc. cit. pl. 1. f. 3 (as *Hemionitis pedata*).

The confusion of *Bommeria pedata* with *B. ehrenbergiana* probably accounts for the reference of the latter species to Guatemala, where it is not now known to occur. Swartz's illustration represents an imperfect frond but is otherwise characteristic.

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

MEXICO: Sierra de San Felipe, Oaxaca, alt. 2,100 to 2,400 meters, *C. L. Smith* 2040. Comaltepec, *Liebmann*. Nogales, Mount Orizaba, alt. 1,260 meters, *Seaton* 41. Tonilá, Colima, Mexico, *Jones* 540. Rio Blanco, Jalisco, 1886, *E. Palmer* 151. Damp shady banks near Guadalajara, Jalisco, alt. 1,350 meters, *Pringle* 1861; *Pringle* 11781. El Parque, Morelos, *Orcutt* 4390. La Venta, Jalisco, *Lemmon*.

GUATEMALA: Patal, near Santa Rosa, Baja Verapaz, alt. 1,600 meters, *von Türckheim* II. 2327. Near Cerro Redonde, Dept. Guajiniquilapa, alt. 1,300 meters, *Lehmann* 1684. Jumaytepeque, Dept. Santa Rosa, alt. 1,800 meters, *Heyde & Lux* (*J. D. Smith* 4086).

Although the relationship of these four species among themselves is evident enough, the actual rank to be assigned to *Bommeria* as a group is not very readily determinable, since there is involved the consideration of many diverse elements coming from a wide geographic area and doubtless representing many separate lines of descent. These elements, which have been variously associated by different writers and concerning which there is at present no general agreement, include species currently referred to *Ceropteris*, *Neurogramma*, *Gymnogramme*, *Hemionitis*, *Gymnopteris* Bernh. (not Presl), and even *Coniogramme* and *Dictyogramme*. The task of arranging the many species of these and closely related genera is an extended one and can not be undertaken in the present paper. It may be worth while, however, to mention a few facts which must be regarded in any serious attempt to reduce the existing confusion.

HEMIONITIS.

The genus *Hemionitis* of Linnæus, typified by the tropical American *Hemionitis palmata*, embraces upward of half a dozen species having the fertile fronds long-stipitate, the blades simply roundish, cordate, or halbert-shaped to palmately 5-parted, the veins copiously anastomosing, and the naked sporangia following the course of the veins nearly throughout and thus forming a delicate regular network over the lower surface. Most of the species are soft-hairy, and their agreement in other general characters is so close as to suggest a common ancestry.

A new species, received recently among other unidentified specimens from Costa Rica, may be described, in honor of its discoverer, as follows:

Hemionitis otonis Maxon, sp. nov.

Plants small, 4.5 to 8 cm. high. Rhizome short, minute, densely clothed with light brownish buff linear-attenuate subentire scales (2 to 3 mm. long), these concolorous or the larger ones marked conspicuously by a castaneous median stripe; fronds

arranged in two series, the smaller ones rosulate, horizontal, mostly sterile, 1.5 to 2.5 cm. long, the stipe from one-half to one-third as long as the small suborbicular-cordate densely pilose lamina; larger fronds two or three, 4.5 to 8 cm. long, stiffly erect or somewhat arcuate, the stipe 2.5 to 5.5 cm. long, pilose, slightly paleaceous at the base, the lamina 2 to 5 cm. broad and long, suborbicular or very obtusely rounded-triangular from a cordate or reniform base, the sinus usually very deep; leaf tissue membrano-papyraceous, repand, finely pilose upon both surfaces; midveins lacking, the veins coarsely areolate without free veinlets, the elongate areoles pentagonal or hexagonal; sporangia following the veins in a thin line throughout.

Type in the U. S. National Herbarium, no. 691252, collected along the road from Ojo de Agua to Brasil (Santa Ana), Costa Rica, July 8, 1911, by Oton Jimenez (no. 333).

From the American species of *Hemionitis* previously known *H. otonis* is readily distinguished by its lesser size and suborbicular leaf blades.

GYMNOPTERIS.

Related to *Hemionitis* is the genus *Gymnopteris* of Bernhardt¹ founded upon the Jamaican *Pteris rufa*, or *Acrostichum rufum* of Linnæus—*Gymnopteris rufa* (L.) Bernh. In soft vestiture and in type and extent of sori the several species are not unlike *Hemionitis*; they differ mainly in their simply pinnate to subbipinnate fronds and free venation. In both *Hemionitis* and *Gymnopteris* the fronds are subfasciculate from a decumbent or ascending rhizome. Underwood² lists two North American species besides the type, namely *Gymnopteris subcordata* and *G. ferruginea*, which certainly must be excluded from this group of species. Both of these are discussed hereafter.

GYMNOGRAMMA.

The genus *Gymnogramme* of Hooker and Baker's *Synopsis Filicum* was treated at some length by Underwood in a paper³ already cited. As published by Desvaux in 1811,⁴ the name was given to an assemblage of 13 species arranged in five groups, according to the subdivision of their fronds, as pinnate, bipinnatifid, bipinnate, tripinnatifid, or decomposite. These species are now apportioned among 6 or 7 genera, and properly so. In determining the nomenclatorial type of the genus *Gymnogramma* Underwood selected the first named species, *Gymnogramma rufa* (the *Pteris rufa* or *Acrostichum rufum* of Linnæus), in which he is justified by the provisions of the American Code, since adopted. Nor is there especial warrant for any other decision, although the name has been variously applied by other writers in recent years, Christensen even regarding *G. flexuosa*,

¹ Journ. Bot. Schrad. 1799: 297. 1799. The name was subsequently used by Presl, mainly for a group of species now usually referred to *Leptochilus* and only remotely related to the genus *Gymnopteris* of Bernhardt.

² Bull. Torrey Club 29: 627. 1902.

³ American Ferns, IV. The genus *Gymnogramme* of the *Synopsis Filicum*. Bull. Torrey Club. 29: 617-634. 1902.

⁴ Ges. Naturf. Freund. Berlin Mag. 5: 304. 1811.

the last named of the original 13 species, as the type of the genus. Fixing its type as *G. rufa*, *Gymnogramma* becomes an exact synonym of *Gymnopteris*, published some 12 years earlier, and therefore need not concern us further. The group of species illustrated by *G. flexuosa* must probably bear the name *Psilogramme* Kuhn. The rest of the original species of *Gymnogramma* are divided among *Gymnopteris*, *Trismeria*, *Anogramma*, *Ceterach*, *Psilogramme*, and the genera commonly known as *Coniogramme* and *Ceropteris*.

The genus *Gymnogramme* of Hooker and Baker included many additional elements, which need not here be recapitulated.

CEROPTERIS AND PITYROGRAMMA.

It has been customary in recent years to refer the *Acrostichum calomelanos* of Linnæus and a few species of unmistakably close alliance (all of them long known as species of *Gymnogramma*) to *Ceropteris*, a genus proposed long ago by Link and restored by Underwood in 1902. *Ceropteris* dates from 1841; and the fact that Link had published the genus *Pityrogramma* in 1833,¹ applying the name to precisely the same group of species, seems to have been wholly overlooked. There is no valid reason why *Pityrogramma* should not displace *Ceropteris*. Two species are listed by Link: *Pityrogramma chrysophylla* Link (*Acrostichum chrysophyllum* Swartz) and *P. calomela* [sic] Link (*Acrostichum calomelanos* L.). The first of these will stand as the type of genus. The other North American species distinguished by Underwood, omitting unnecessary synonymy, are:

***Pityrogramma triangularis* (Kaulf.) Maxon.**

Gymnogramma triangulare Kaulf. Enum. Fil. 73. 1824.

***Pityrogramma viscosa* (D. C. Eaton) Maxon.**

Gymnogramme triangularis viscosa D. C. Eaton, Ferns N. Amer. 2: 16. 1880.

Ceropteris viscosa Underw. Bull. Torrey Club 29: 631. 1902.

***Pityrogramma tartarea* (Cav.) Maxon.**

Acrostichum tartareum Cav. Descr. Pl. 242. 1801.

***Pityrogramma peruviana* (Desv.) Maxon.**

Gymnogramma peruviana Desv. Ges. Naturf. Freund. Berlin Mag. 5: 329. 1811.

***Pityrogramma triangulata* (Jenman) Maxon.**

Gymnogramma triangulata Jenman, Bull. Bot. Dept. Jamaica II. 4: 206. 1897.

***Pityrogramma sulphurea* (Swartz) Maxon.**

Acrostichum sulphureum Swartz, Prodr. Veg. Ind. Occ. 129. 1788.

To these must be added the following single species, which ranges from Costa Rica and Panama to Peru:

***Pityrogramma ferruginea* (Kunze) Maxon.**

Gymnogramme ferruginea Kunze, Linnaea 9: 34. 1835.

Gymnogramme bommeri Christ, Bull. Soc. Bot. Belg. 35: 237. 1896.

Gymnopteris ferruginea Underw. Bull. Torrey Club 29: 628. 1902.

¹ Link, Handb. Gewächse. 3: 19. 1833.

Except for its very dense hairy covering, *P. ferruginea* agrees closely with the largest species of *Pityrogramma* in every respect and has no near relationship with *Gymnopteris*, in which genus it was placed by Underwood.

NEUROGRAMMA.

The genus *Neurogramma*, proposed by Link¹ in 1841, has as its type *Acrostichum rufum* L., and thus, like *Gymnogramme*, is exactly synonymous with *Gymnopteris* Bernh. (not Presl) and has no standing. As taken up by Diels,² however, it is greatly extended and contains, besides the type species and its near allies, several distinct elements, among them the generic group which, as shown above, must bear the name *Pityrogramma*.

The name *Gymnopteris* is not employed by Diels in the sense of Bernhardt and Underwood, but is instead applied erroneously to the group called *Leptochilus* by Christensen, which is also, roughly, its application by Presl.

CONIOGRAMME.

Reference has been made under *Gymnopteris* (p. 172) to a Mexican plant described as *Gymnogramme subcordata* Eaton & Davenp.,³ which was transferred to *Gymnopteris* by Underwood. A critical examination of the type material of this species in the U. S. National Herbarium shows that it is, instead, a member of the genus currently known as *Coniogramme* and that it is nearly related to *Coniogramme japonica*, as Eaton had suggested. The venation is correctly described by Davenport as follows:

Veins uniting below into two series of long irregular areolæ, the lower series parallel with the costa, the secondary series obliquely ascending, forked once or twice above and free to the edge; sori confined to the free veinlets.

The venation is not, however, shown in the published illustration. Large fronds are subbipinnate, a feature which, in connection with the peculiar venation and stramineous stipes and rachises, makes the reference of this plant to *Coniogramme* a very natural one. It may be known as *Coniogramme subcordata* (Eaton & Davenp.) Maxon.

Coniogramme Fée,⁴ founded upon the free-veined forms of this alliance, is regarded by Diels and Christensen as including *Dictyogramme* Fée,⁵ which was founded upon the areolate Japanese species, already mentioned, first described as *Hemionitis japonica* Thunb. Habitally the two groups are alike and should probably be joined. It is possible, however, that Presl's name *Dyctiogramme*, published

¹ Link, Fil. Hort. Berol. 138. 1841.

² Diels in Engl. & Prantl, Pflanzenfam. 14: 262. 1899.

³ Contr. U. S. Nat. Herb. 5: 138. pl. 16. 1897.

⁴ Gen. Fil. 167. 1852.

⁵ Gen. Fil. 170. 1852.

in the *Epimeliæ Botanicae*,¹ may antedate the two proposed by Fée. The title-page date of 1849 for the *Epimeliæ* is known to be incorrect, and recently 1851 has been taken as the true date of publication. It has not been shown satisfactorily, however, that the completed work appeared earlier than 1852.² Under these circumstances preference should be given to Fée.

SUMMARY.

The above notes are intended to show that *Neurogramma* and *Gymnogramma*, each typified by *Acrostichum rufum*, are properly synonyms of *Gymnopteris*, itself founded upon the same species; that *Pityrogramma* must replace *Ceropteris*, as applied to the rather small genus of ferns of which *Acrostichum calomelanos* L. and *A. chrysophyllum* Swartz are familiar examples; that two of the species included under *Gymnopteris* by Underwood are not properly referable to that genus, one being here transferred to *Pityrogramma*, the other to *Coniogramme*, which is a genus not hitherto recognized from America; and that *Gymnogramma*, as it has been understood by most authors in the past, comprises many distinct generic elements, as emphasized by Underwood. Whether *Bommeria* itself can be successfully maintained as distinct from *Hemionitis* is doubtful. Christensen, indeed, transfers it bodily to *Gymnopteris* and maintains *Gymnopteris* as distinct from *Hemionitis*. It would have been quite as logical to merge both *Bommeria* and *Gymnopteris* under *Hemionitis*. As a matter of fact, the satisfactory arrangement of the species of this entire group must await the careful analysis and comparison of very many and widely divergent forms, many of them from distant regions and referred to still other genera. The present notes may be of assistance in that connection.

NEW SPECIES OF LYCOPODIUM.

The following species of *Lycopodium* from Guatemala, Costa Rica, and Panama appear to be distinct from any hitherto recognized. There are at hand also several other collections which probably represent undescribed species but which, either on account of insufficiency of material for full diagnosis or the need of comparison with little known species of South America, must await later study. Lack of complete South American material prevented a full treatment of the tropical American species by Underwood and Lloyd in their paper³ of 1906, although the North American members of the genus are, with a few exceptions, now tolerably well understood.

¹ Page 263.

² Upon this question see Hooker, *Journ. Bot.* 4: 286. 1852; J. Müller in A. DC. *Prodr.* 15: 258. 1862; Barnhart, *Bull. Torrey Club* 32: 590 (footnote). 1905.; Underwood, *Bull. Torrey Club* 33: 39 (footnote). 1906.

³ *Bull. Torrey Club* 33: 101-124. 1906.

Lycopodium brachiatum Maxon, sp. nov.

PLATE 7.

Plants apparently terrestrial, ascending, 15 to 20 cm. long, 3 to 5 times dichotomous, the branches spreading, widely divaricate (60° to 90°), the tips (if fertile) almost continuously sporangiate for a distance of 2 to 6 cm. Stems very slender (about 0.5 mm. in diameter), wholly concealed by the appressed imbricate bases of the very numerous closely set leaves; leaves apparently in 8 ranks, not twisted at the base, all alike, slightly ascending, somewhat secund, membranous, 5 to 6 mm. long, linear-subulate from a linear-lanceolate base (this about 0.5 mm. broad), subcapillary at the tips, entire, the upper surface usually somewhat concave in drying, often deeply so near the base, the basal portion of the leaf sometimes plicate, the apical portion often irregularly tortuous; costa percurrent, relatively prominent, readily visible by transmitted light, distinctly elevated below, the base of the leaf strongly carinate; sporophylls like the sterile leaves, not reduced in size; sporangia reniform to obtusely cordate-reniform, about 0.8 mm. broad, the sinus very deep.

Type in the U. S. National Herbarium, no. 22259, collected upon Cocos Island, off the western coast of Costa Rica, February 28, 1891, by Dr. Alexander Agassiz, during the cruise of the U. S. Bureau of Fisheries steamer *Albatross*.

An aberrant member of the group of *L. verticillatum* L. and nearest related to *L. portoricense* Underw. & Lloyd,¹ which is known only from Porto Rico. Like that species *L. brachiatum* appears to be terrestrial, which is unusual for members of the *verticillatum* group. It differs from *L. portoricense* mainly in its strongly divaricate branches (those of *L. portoricense* diverging at an angle of 30° to 45°) and in its fewer, shorter, more spreading, 8-ranked leaves, those of *L. portoricense* being 6 to 8 mm. long, ascending, and arranged in 10 ranks.

EXPLANATION OF PLATE 7.—One of the type specimens of *Lycopodium brachiatum*. Natural size.

Lycopodium chiricanum Maxon, sp. nov.

PLATE 8.

Plants terrestrial, caespitose, 8 to 12 cm. high, the main stems crowded, erect from an arcuate base, 1 to 3 times dichotomous, the branches erect and closely fasciculate. Stems stout, 6 to 8 mm. in diameter (including the leaves), densely leafy, the branches similarly stout and equally leafy throughout, the apices sporangiate a distance of 2 to 4 cm. or more, the sporangia wholly concealed by the sporophylls; leaves distinctly 10-ranked upon the lower stem, 11 or 12-ranked toward the apex, crowded, radially arranged, not twisted, ascending, densely imbricate, 3.5 to 5 mm. long, about 1 mm. broad, narrowly oblong, gradually acute in the apical third, not narrowed at the base, more or less cymbiform, the outer surface usually convex, the tip incurved, the inner surface flattish or slightly concave; leaf tissue chartaceo-coriaceous, more or less spongy, the leaf often wrinkled in drying; margins hyaline, minutely denticulate-serrulate (most noticeably so in the apical half), the teeth gland-like, variable in shape and position, sometimes low or even rounded; costæ percurrent but wholly concealed, their presence indicated by a dorsal ridge near the base or sometimes nearly throughout; sporophylls closely imbricate, similar to the sterile leaves but somewhat narrowed at the base, exactly lanceolate; sporangia reniform, 1.5 to 1.7 mm. broad, the sinus very broad and open.

Type in the U. S. National Herbarium, no. 675719, collected upon rocky open slopes of the summit of Chiriqui Volcano, Panama, altitude about 3,370 meters, March 12, 1911, by William R. Maxon (no. 5364).

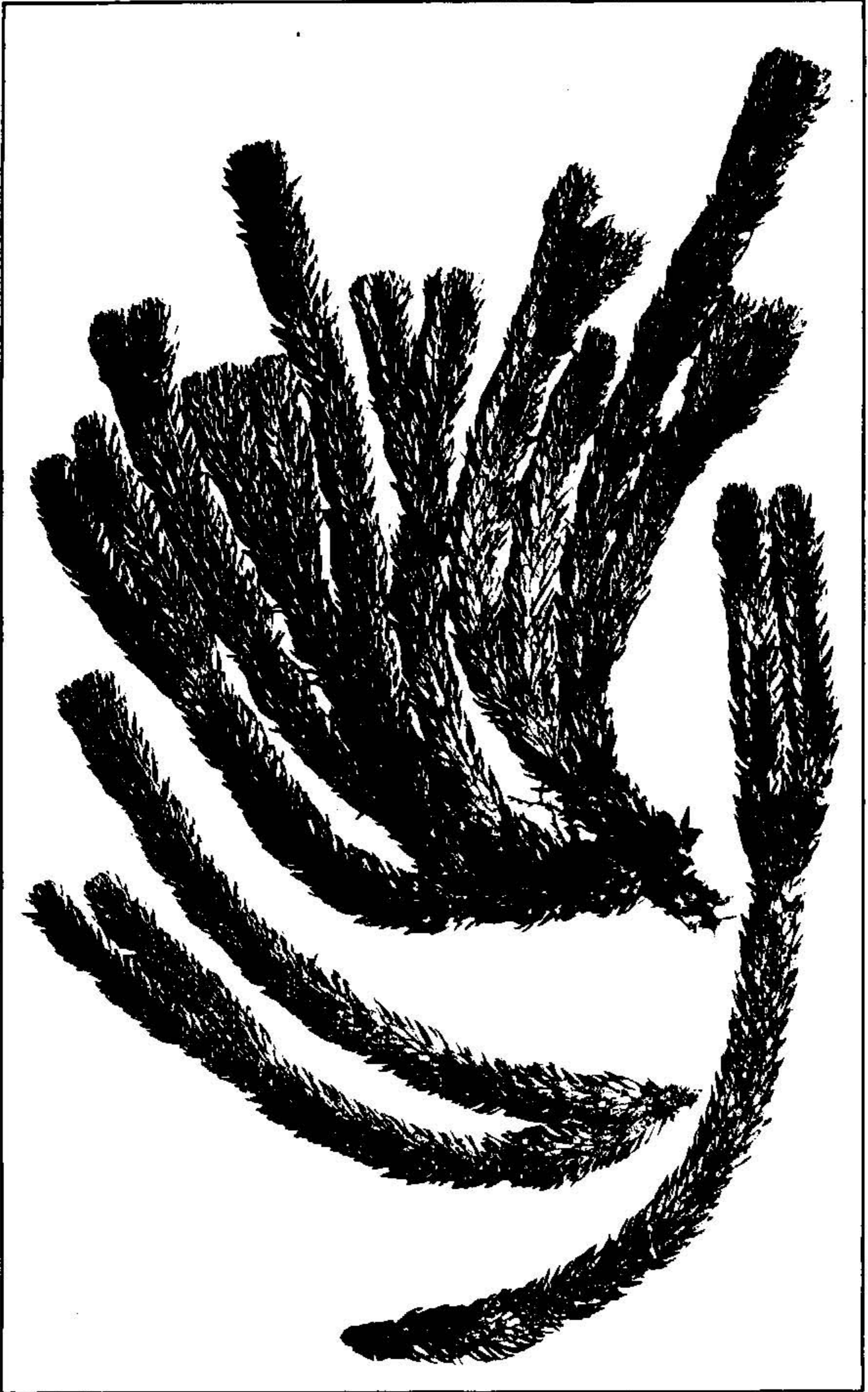
Lycopodium chiricanum is not closely related to any North American species. Only a few South American members of the *selago* subgroup, to which this species belongs, have the leaves arranged in so many as 10 rows, and from these *L. chiricanum* seems altogether distinct. The foliage may be described as lutescent, or of a vivid yellowish green. There is no trace of red, as in many allied species.

EXPLANATION OF PLATE 8.—Type specimens of *Lycopodium chiricanum*. Natural size.

¹ Bull. Torrey Club 33: 108. 1906.



LYCOPodium BRACHIATUM MAXON.



LYCOPodium CHIRICANUM MAXON.



LYCOPODIUM GUATEMALENSE MAXON AND L. UNDERWOODIANUM MAXON.

***Lycopodium guatemalense* Maxon, sp. nov.**

PLATE 9, a.

A delicate, diffuse, pendent epiphyte, 20 cm. long, 7 or 8 times dichotomous, interruptedly sporangiate in the apical half or two-thirds. Stem very slender (about 0.6 mm. in diameter), dull vermilion, the numerous branches of the same color, slender (0.3 to 0.5 mm. in diameter), slightly flexuous nearly throughout; leaves distant, borne in 6 or 8 ranks, spreading, strongly falcate, dull green, delicately membranaceous, very narrowly linear-lanceolate, 8 to 10 mm. long, 0.6 to 0.8 mm. broad, long-attenuate (the tips pungent, often reddish), entire, all somewhat twisted near the base, flat or the lower surface concave in drying, the leaf sometimes even subtubulose; costa medial, percurrent, visible upon the upper surface only near the tip (its course elsewhere marked often by a narrow furrow), evident beneath except toward the tip, the lower surface thus delicately carinate nearly throughout, the costa reddish at the base, strongly elevated, and together with the reddish leaf tissue long-decurrent upon the stem; sporophylls conform, arranged in zones 2 to 4 cm. long; sporangia suborbicular-reniform (the sinus rather shallow), averaging about 1 mm. broad, protruding beyond the twisted bases of the sporophylls a distance of 0.3 to 0.35 mm. on each side.

Type in the U. S. National Herbarium, no. 827041, collected upon tree trunks at Pansamalá, Alta Verapaz, Guatemala, altitude about 1,200 meters, July, 1886, by H. von Türckheim and distributed by Capt. John Donnell Smith as no. 957, *Lycopodium linifolium* var. *sanguineum* Spring.

Allied to *Lycopodium linifolium* L. and the Costa Rican *L. underwoodianum* Maxon¹ (Pl. 9, b); differing conspicuously from the former in its red stems, lesser size and more slender, strongly falcate leaves. From the latter it is readily distinguished by its reddish stems throughout, its lesser size and its much darker and broader leaves. Although a lax plant, it is much less so than *L. underwoodianum*, which is the most delicate species of the entire genus.

EXPLANATION OF PLATE 9.—Portions of type specimen of (a) *Lycopodium guatemalense*; (b) *L. underwoodianum* (Maxon 213). Both natural size.

***Lycopodium lancifolium* Maxon, sp. nov.**

Plants epiphytic, pendent, 20 to 30 cm. long, 5 to 8 times dichotomous, the branches laxly disposed, discontinuously sporangiate in the apical part. Stems slender (0.5 to 0.7 mm. in diameter), stramineous to light greenish, straight or nearly so, only partially concealed by the leaves; leaves yellowish green, herbaceous, ascending but not at all appressed, borne in 6 ranks, somewhat dorsiventrally arranged, those of the 4 lateral and upper rows more or less twisted at the base, those of the 2 under rows straight, the leaves otherwise all alike, narrowly lanceolate, attenuate, 7 to 10 mm. long, 1 to 1.5 mm. broad, slightly falcate in the outer part, entire, flat or the upper surface slightly convex; costa percurrent, nearly concealed above, visible in the outer part only by transmitted light, apparent below in the basal half of the leaf as a distinct ridge, the strongly carinate base decurrent, the stem thus appearing sharply angled; sporophylls similar to the sterile leaves but mostly smaller (5 to 7 mm. long), and slightly broadest at the base; sporangia orbicular-reniform, about 0.9 mm. broad.

Type in the U. S. National Herbarium, no. 676072, collected from the fallen branch of a large tree in dense humid forest along the upper Caldera River, near "Camp I," Holcomb's trail, above El Boquete, Chiriqui, Panama, altitude about 1,650 meters, March 23, 1911, by William R. Maxon (no. 5627). Other specimens (Maxon 5638) were gathered in the same vicinity at a slightly greater elevation.

Lycopodium lancifolium is allied to *L. linifolium*, but differs materially in its more slender, more sharply angled and less herbaceous stems, and especially in having the leaves very much shorter, relatively much broader (truly lanceolate instead of linear

¹ Contr. U. S. Nat. Herb. 13: 41. 1909.

to linear-lanceolate), less conspicuously costate, and of a much firmer texture. It is not likely to be mistaken for *L. linifolium* under any circumstances. Superficially only it somewhat resembles lax forms of *L. taxifolium*, though it is readily distinguished by its slender stems, and by its more distant, nonimbricate, and less rigid, 6-ranked leaves. The relationship with *L. taxifolium* is not close.

Lycopodium tubulosum Maxon, sp. nov.

PLATE 10.

Plants epiphytic, pendent, 20 cm. long, 4 to 6 times dichotomous (the ultimate branches numerous and loosely fasciculate), continuously sporangiate in the apical third. Stems slender (0.6 to 0.8 mm. in diameter), partially obscured by the rather dense covering of leaves near the base, less so above, coarsely subflexuous; leaves dull yellowish green, rather rigidly membrano-herbaceous, strongly ascending, obscurely 6-ranked, mostly twisted near the base (the torsion often continued nearly throughout), the leaves thus somewhat dorsiventrally arranged, linear-lanceolate to subligulate, 10 to 13 mm. long, 1.2 to 1.4 mm. broad, narrowly acute, slightly narrowed at the base, falcate, entire, flattish or the inner surface more or less concave in drying; costæ percurrent, medial, evident as a slender dorsal ridge, stronger toward the base; sterile leaves of the upper branches gradually smaller, 5 to 7 mm. long, narrower, linear-acicular, concave or inwardly subtubulose, especially near their base; sporophylls 3 to 5 mm. long, strictly ascending, incurved, lance-acicular in outline, the bases about 1 mm. broad, carinate, strongly concave within and almost completely sheathing the sporangia, the sporophylls above this rather abruptly narrowed, tubulose except at the flattish acute tips; sporangia orbicular-reniform, about 1 mm. broad.

Type in the U. S. National Herbarium, no. 861142, collected at Pacayas, at the foot of the Volcano Turrialba, Costa Rica, altitude 1,400 meters, December, 1908, by P. Biolley, jr. (no. 17398).

Lycopodium tubulosum is related to *L. taxifolium* Swartz, but departs widely from that in all essential characters. It is very much more slender and is smaller in all its parts, with very numerous, loosely fasciculate, lax, fertile branches, very much smaller, narrower and differently shaped leaves, and sporangia half the size of those of *L. taxifolium*. It shows an alliance to that species chiefly in its tortuous leaves and tubulose sporophylls. The last feature, however, is not an invariable character of *L. taxifolium* and is to be observed only in certain very large and fully mature individuals which are uncommonly fertile and have the sporophylls much reduced and very different in shape from the sterile leaves. Other (mostly younger) specimens of *L. taxifolium* have the sporophylls of precisely the same size and shape as the sterile leaves. The sporophylls of *L. tubulosum* are strongly incurved (which is not true for any form of *L. taxifolium*), and their tubulose condition is not affected by water.

Agreeing closely with the type are the following additional specimens, both in the U. S. National Herbarium:

COSTA RICA: From tree trunks along the Agua Caliente, Finca Navarro, alt. 1,350 meters, May 21 to 23, 1906, *Maxon* 695. La Palma (on the Atlantic slope), alt. about 1,520 meters, July 22, 1888, *Pittier* 272.

EXPLANATION OF PLATE 10.—Apical portion of one of the type specimens of *Lycopodium tubulosum*. Natural size.

A NEW CYATHEA FROM SANTO DOMINGO.

There have recently been described by Brause¹ five new species of *Cyathea* from the West Indies, as follows: *Cyathea tenuis* from Cuba, and *Cyathea urbani*, *C. hieronymi*, *C. domingensis*, and *C. irregularis* from Santo Domingo. These, which appear to be valid, with the

¹ In Urban, *Symb. Antill.* 7: 151-155. 1911.



LYCOPodium TUBULOSUM MAXON.

following single new species, make a total of forty-nine to be recognized from North America.¹

Cyathea asperula Maxon, sp. nov.

Caudex, stipes, and shape of lamina unknown; lamina presumably about 2 meters long, 70 cm. broad, deeply tripinnatifid, the primary rachis slender (about 4 mm. thick), olivaceous, minutely and deciduously furfuraceous, sparingly beset with small slender straight spines about 0.5 to 1 mm. long; pinnæ subopposite, sessile, oblong, abruptly acuminate, 30 to 35 cm. long, 11 to 14 cm. broad, the secondary rachis slender, yellowish brown, strigose above, below scabrous or asperulous only toward the base, the spines very minute; pinnules about 18 pairs, narrowly oblong, long-acuminate to subcaudate, 5 to 7 cm. long, 15 to 18 mm. broad, contiguous or nearly so, subsessile, spreading, cut nearly to the costa at the base, less deeply outward, the costal wing about 1 mm. broad upon each side toward the apex, the costa slender, laxly strigose above, below bearing numerous minute strongly bullate roundish bright brown scales (with slender long-pointed tips) and toward the base a few linear scales (1 to 1.5 mm. long) with minutely fimbriate margins, the teeth mostly gland-tipped; segments 12 to 14 pairs, slightly falcate, obtuse, 8 to 10 mm. long, 3.5 to 4 mm. broad, the basal pair constricted and apart, coarsely incised and commonly semihastulate upon the proximal margin, the others not constricted, slightly dilatate, separated by narrow linear sinuses, the margins lightly serrate-crenate; costules slender, bearing 3 or 4 spine-like hairs above, below bearing numerous minute bullate scales (like those of the costa) and a few distant curved hairs; veins 6 to 8 pairs, oblique, mostly once forked; sori nearly medial; indusium globose, yellowish brown, delicately membranous, rupturing irregularly, the divisions subpersistent on all sides; receptacle capitate, conspicuously setiferous.

Type in the U. S. National Herbarium, no. 690466, collected in forests near Constanza, Santo Domingo, altitude 1,250 meters, March, 1910, by H. von Türckheim (no. 3056); distributed as *Cyathea muricata* Willd.

Cyathea asperula is an exceedingly well marked species. From *Cyathea tenera* (J. Smith) Griseb., which has similarly muricate or minutely spiny rachises, it differs in its copious covering of bullate scales upon the costa and costules, and in being nearly devoid of hairs below (instead of strongly pubescent upon the costæ, costules, and veins), as well as in its fewer pinnules, fewer and differently shaped segments, and in other obvious characters.

¹ See N. Amer. Fl. 16: 65-88. 1909.