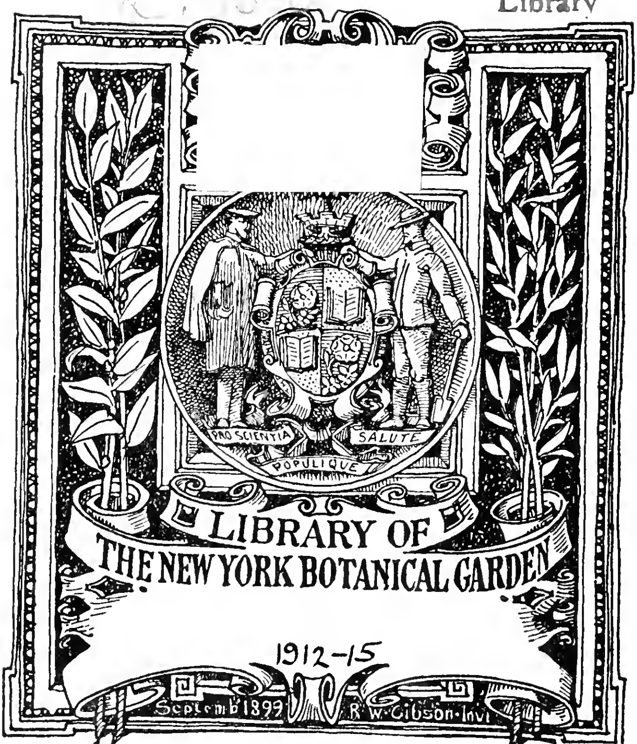
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STUDIES ON THE ROCKY MOUNTAIN FLORA—XXVI

By PER AXEL RYDBERG

NEW YORK
1912

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Studies on the Rocky Mountain flora—XXVI

PER AXEL RYDBERG

PINACEAE and JUNIPERACEAE

In the New Manual of Botany of the Central Rocky Mountains no reference is made to *Picea canadensis*, although it has been collected in the Black Hills of South Dakota and Wyoming. Blankinship in his supplement to the Flora of Montana,* reports *P. alba*, which is the same, from four localities in Montana. This, however, I think is erroneous. All specimens from Alberta, British Columbia, and Montana, that I have seen determined as *P. canadensis* or *P. alba*, belong to *P. albertiana* S. Brown. Probably the specimens reported by Blankinship belong there also. *Abies grandis* is also omitted in the New Manual. This is not uncommon in Montana west of the continental divide. Perhaps that part of the state is not intended to be included in the range covered by the New Manual, as it includes only "most of Montana." The species has been reported from the Yellowstone Park, but the reference is uncertain. Blankinship, loc. cit., also reports *Juniperus virginiana* from Montana and cites three localities. I have no evidence that the determinations were correct nor have I seen any specimens from the state. What makes me more doubtful as to the correctness of the determination is that two of the localities are situated west of the continental divide, and at Bozeman, the third locality, I have myself collected during parts of three summers and have not seen it.

I doubt very much if *Juniperus Knightii* A. Nelson can be upheld as a species distinct from *J. utahensis* (Engelm.) Lemmon. The characters given, apparently do not hold. The leaves are supposed to be 2-ranked in *J. monosperma* and *J. utahensis* and 3-ranked in *J. Knightii*. I know that in the first two they are both 2- and 3-ranked. I have not seen the type of *J. Knightii*, but in a specimen distributed under that name by Professor Nelson

* Montana Agr. Coll. Sci. Stud. Bot. **1**: 39. 1905.

himself the leaves are both 2- and 3-ranked on different twigs of the same branch. The seeds in *J. utahensis* are either obtuse or acutish at the apex, and these characters do not furnish any distinction. I have spoken to Dr. J. A. Shafer, who helped Dr. N. L. Britton in preparing North American Trees, and he told me that he had come to exactly the same conclusion as I.

The following two changes in the nomenclature seem to be advisable.

Hesperopeuce Mertensiana (Bong.) Rydb. comb. nov.

Pinus Mertensiana Bong. Mem. Acad. Sci. Nat. St. Petersb. VI. **2**: 163. 1832.

Abies Mertensiana Lindl. & Gord. Journ. Hort. Soc. Lond. **5**: 211. 1850.

Abies Pattoniana Jeffrey; A. Murray, Rep. Oregon Exped. 1. 1853.

Tsuga Pattoniana Sénéc. Conif. 21. 1867.

Hesperopeuce Pattoniana Lemmon, Rep. Calif. State Board Forestry **3**: 126. 1890.

Tsuga Mertensiana Sargent, Silva **12**: 77. 1898. Not *T. Mertensiana* Carrière, 1867.

I agree fully with Mr. Lemmon that this species should be removed from *Tsuga*. Both its cones and its leaves are more like those of a spruce than those of a hemlock, and the habit of the tree is different from both. Mr. Lemmon, however, did not adopt the oldest available specific name.

Sabina horizontalis (Moench) Rydb. comb. nov.

Juniperus horizontalis Moench, Meth. 699. 1794.

Juniperus prostrata Pers. Syn. **2**: 632. 1807.

Juniperus Sabina procumbens Pursh, Fl. Am. Sept. 647. 1814.

Sabina prostrata Antoine, Cupress. Gatt. 57. 1857–70.

EPHEDRACEAE

Marcus E. Jones* reduced *Ephedra viridis* Coville to a variety of *E. nevadensis*. I do not know exactly what *E. viridis* is, as I have not seen the type, but the Utah plant which Jones had in mind, does not seem to agree with the description. We have duplicates of some of the numbers cited by Jones, and these seem to be typical *E. nevadensis*.

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* Proc. Calif. Acad. II. **5**: 726. 1895.

SPARGANIACEAE

Sparganium simplex L. has been reported again and again from the Rocky Mountains, but all the specimens I have seen under that name belong either to *S. longipedunculatum* (Morong) Rydberg or to *S. angustifolium* Michx. *S. longipedunculatum* resembles *S. simplex* much in habit but is usually more slender, and the leaves are not so triangular-keeled as in that species. The main difference is, however, in the shorter style and stigma. *S. simplex* is very rare in the United States. I have seen specimens only from the State of Washington. It is otherwise found in British Columbia and along the St. Lawrence River in Ontario and Quebec.

ZANNICHELLIACEAE

Potamogeton perfoliatus is not found in the Rocky Mountain region. It is there represented by *P. Richardsonianus*. Notwithstanding the fact that N. Taylor includes the latter in the former, I am convinced that they are distinct. This opinion is based on field studies. My contentions are also supported by M. L. Fernald.

I cannot find any specific distinctions between *Ruppia curvicarpa* A. Nels. and *R. maritima* L. The length of the pedicels is merely a matter of age and other conditions; the typical *R. maritima* has strongly oblique fruit, gibbous at the base as described in *R. curvicarpa;* slender or stout, straight and curved styles are found in the same individual even. Taylor, also, could find no distinctive characters.

ALISMACEAE

Alisma Plantago-aquatica L. is not found in America. In this European species the achenes have different beaks from those found in the North American species. The common species of the Rocky Mountain region should be known as *A. brevipes* Greene. *Alisma Geyeri* Torr. is also found in the regions. (See my Flora of Montana.) It has been collected later in Utah.

Blankinship* described one new species and one new variety of *Sagittaria*. *S. paniculata* Blank. is but a well developed *S.*

* Loc. cit. 40.

arifolia Nutt.,* and *S. arifolia tenuior* is but a depauperate form of the same. Both *S. paniculata* Blank. and *S. arifolia* Nutt. have to give way for the older name *S. cuneata* Sheldon,† which was described from the deep-water form of the same species.

POACEAE

Blankinship reported *Panicum nitidum* Lam. from Columbia Falls, Montana. This must be an error, for that species is known only from the eastern seaboard from southern Virginia to eastern Texas. *Aristida fasciculata Hookeri* of Blankinship's list is the same as *A. longiseta*.

Professor Nelson reports *Aristida oligantha* from Colorado. I have seen no specimens from that state and none from west of central Nebraska. Perhaps *A. bromoides* might have been mistaken for it.

The oldest available specific name for *Eriocoma cuspidata* is *hymenoides*, which is therefore adopted, and its name and synonymy is as follows:

Eriocoma hymenoides (R. & S.) Rydb. comb. nov.

Stipa membranacea Pursh, Fl. Am. Sept. 728. 1814. Not *S. membranacea* L. 1753.
Stipa hymenoides R. & S. Syst. **2**: 339. 1817.
Eriocoma cuspidata Nutt. Gen. **1**: 40. 1818.
Oryzopsis cuspidata Benth.; Vasey, Special Rep. U. S. Dept. Agr. 63: 23. 1883.

The following species of *Muhlenbergia* should be added to the flora of the Rocky Mountain region: *M. pauciflora* Buckl. (*M. neomexicana* Vasey; *M. Pringlei* Scribn.), *M. polycaulis* Scribn., and *M. curtifolia* Scribn., which were collected by Professor A. O. Garrett and myself in southeastern Utah last summer. *Alopecurus fulvus* Smith is not found in America, except perhaps in Greenland. *A. aristulatus* Michx. is not the same, differing not only in the general habit, not being depressed-geniculate, but also in the different position of the awn of the floral glume. *Alopecurus pallescens* Piper has been collected in both Idaho and Montana.

---

* J. G. Smith. Rep. Missouri Bot. Gard. **6**: 32. 1894.

† Bull. Torrey Club **20**: 283. 1893.

Professor Nelson, in the New Manual, includes *Sporobolus vaginaefolius* and *Cinna arundinacea*, which I think are erroneously reported for the region.

The following species of *Calamagrostis* have to be included in the Rocky Mountain flora: *C. Vaseyi* in Montana, *C. rubescens* and *C. lucida* in Wyoming.

Professor Nelson reduced *Avena americana* to a synonym of *A. Mortoniana*. I think they are distinct, but if united, they should bear the name *Avena Hookeriana*, an older name for the former. *Arrhenatherum elatius* has been collected in Colorado, and *Danthonia spicata* is common in the Black Hills.

Deschampsia pungens sp. nov.

A densely tufted perennial; stem 3–4 dm. high, glabrous and shining; basal leaves numerous, the old subchartaceous sheaths from preceding season remaining, strongly striate, glabrous, often slightly tinged with purplish; ligules triangular-lanceolate, 4–5 mm. long: blades spreading, more or less arcuate, strongly involute, bluish green or in age straw-colored, strongly striate, minutely scabrous-pruinose, stiff and with a callous pungent point; stem leaves few; blades 2–5 cm. long, similar; panicle open, branches in age spreading; peduncle and its branches more or less purplish, glabrous or minutely scabrous; empty glumes subequal, 3.5–4.5 mm. long, lanceolate, acute, purple, with scarious margins; rachis long-hairy; floral glumes 3–3.5 mm. long, similar to the empty glumes; awn attached near the base, equaling or barely exceeding the floral glume.

This species is closely related to *D. caespitosa* but differs in the stiff, involute, pungent-pointed leaves and in the position of the dorsal awn of the floral glumes. This is attached near the base of the glume, while in *D. caespitosa* it is attached one fourth or one fifth the distance from the base. It grows near hot springs.

ALBERTA: Along stream below warm sulphur springs, vicinity of Banff, July 10, 1899, *McCalla 2309* (type in herb. N. Y. Bot. Gard.).

WYOMING: Lower Geyser Basin, Yellowstone Park, August 4, 1897, *Rydberg & Bessey 3590*.

Chloris brevispica Nash has been collected at Wray, Colorado, and *Blepharidachne Kingii* (S. Wats.) Hackel (*Eremochloa Kingii*

S. Wats.) in eastern Utah, *Eragrostis lutescens* Scribn. and *E. hypnoides* Nees in Idaho, *E. secundiflora* Presl in Colorado, and *E. neomexicana* Vasey in southern Utah. *Briza maxima* L. has become introduced in Colorado.

Poa Multnomae Piper and *P. ampla* Merrill have been collected in Montana since 1909. *Poa flava* L. is not a *Poa* at all, as shown by Professor A. S. Hitchcock, and the name to be used for *P. serotina* Ehrh. is *P. triflora* Gilib. *Poa laxa* Haenke is not found in the Rocky Mountains, and what has been masquerading under that name is *P. alpicola* Nash. *Poa paddensis* Piper is an older name for *P. subpurpurea* Rydb., both being based on *P. purpurascens* Vasey. In the New Manual no reason is given why *P. Buckleyana* Nash, published in 1895, should be used instead of *P. Sandbergii* Vasey of 1893. They may be the same. *P. Buckleyana* Nash was a substitute for the untenable *P. tenuifolia* Buckl., while *P. Sandbergii* was described independently. I have not seen Buckley's type, but it is supposed to have been based upon the manuscript *P. tenuifolia* Nutt. Dr. A. Gray accused Buckley of having pilfered the species from Nuttall. There is in the herbarium of the New York Botanical Garden a specimen named by Nuttall *P. tenuifolia*, and this specimen belongs to *P. Sandbergii*. What has usually passed under the names *P. tenuifolia* and *P. Buckleyana* is different, and I think represents a distinct although closely related species. The grass common in Wyoming and Colorado belongs to this and not to the typical *P. Sandbergii*, which ranges only west of the continental divide.

Although *Poa pseudopratensis* Scribn. & Rydb. resembles the common bluegrass in habit it is entirely distinct from it and more closely related to *P. arida* Vasey. Like that species it lacks the cobweb at the base of the floral glumes altogether, while *P. pratensis* has the best developed cobweb of all our species. Likewise *P. phoenicea* Rydb., also cited as a synonym under *P. pratensis* in the New Manual, has no cobweb and belongs in another section of the genus. I am inclined to think that *P. phoenicea* Rydb. is the same as the original *P. Grayana* Vasey, while *P. Grayana* of my Flora of Colorado is a large-flowered *P. Pattersonii* or a closely related species.

Poa crocata Michx. is the same as *P. caesia strictior*. In the

Torrey Herbarium there are a few spikelets of *P. crocata* Michx., and I have seen the type of *P. caesia strictior*. The plant is the most common species that has been known under the name *P. nemoralis* in the Rockies. It is intermediate between *P. interior* Rydb. and *P. rupicola* Nash, in habit resembling more the latter, but the cobweb is present.

In the New Manual of Botany of the Central Rocky Mountains, *Poa Tracyi* Vasey, *P. flexuosa occidentalis* Vasey, *P. occidentalis* Rydb., and *P. callichroa* Rydb. are given as synonyms under *P. nervosa* (Hook.) Vasey. In *P. callichroa* the cobweb is present, and that species is related to *P. arctica* although much larger. In the rest the cobweb is wanting. The plant described by Professor Nelson is *P. occidentalis* (Vasey) Rydb. If *P. Tracyi* Vasey is the same I do not know, but *P. nervosa* (Hook.) Vasey is a different plant. A duplicate of the type is in the Torrey Herbarium. In this species the glumes are very thin and the nerves very prominent, stronger than in any other species of *Poa* known to me.

Poa californica, *P. andina* Nutt., and *P. brevipaniculata* S. & W. are given as synonyms under *P. Fendleriana*. *Poa brevipaniculata* is very hard to distinguish from *P. Fendleriana* and may well be reduced to synonomy. *Poa californica*, under which name *P. Fendleriana* has been masquerading and under which it is described in the old Coulter's Manual, is an entirely different plant, related to *P. nevadensis* and *P. Buckleyana* and not found in the Rocky Mountain region. *P. andina* Nutt. is also entirely distinct. *P. arida* Vasey and *P. pratericola* Rydb. & Nash were based on *P. andina* Nutt. These two as well as *P. juncifolia* Scribn. are cited by Nelson as synonyms under *P. Sheldonii* Vasey. *P. arida* and *P. Sheldonii* are closely related to each other but *P. juncifolia* is more closely related to *P. laevigata*.

In *Festuca* the following species have been collected in the Rocky Mountains: *F. pacifica* in Utah and Idaho, *F. reflexa* in Utah, *F. megalura* in Idaho, *F. ovina calligera* Piper in Utah, *P. idahoensis* Piper in Idaho, *F. viridula* Vasey in Idaho, and *F. dasyclada* in Utah. *Festuca Thurberi* is one of the best species in the genus, characterized by its long acuminate ligules. It stands in the same relationship to *F. campestris* and *F. scabrella*, as *Poa longiligula* does to *Poa Fendleriana* and *P. brevipaniculata*.

I regard the subgenus *Hesperochloa* of *Festuca*, proposed by Piper, as representing a distinct genus and here propose it as such.

HESPEROCHLOA (Piper) Rydb. gen. nov.

Festuca subgenus *Hesperochloa* Piper, Contr. U. S. Nat. Herb. **10**: 10. 1906.

Densely tufted dioecious perennial, occasionally stoloniferous. Inflorescence a narrow panicle. Spikelets turgid, 3–5-flowered; rachilla scabrous on the basal half. Empty glumes 2, broadly lanceolate, subscarious, shining, the lower 1-nerved, the upper 3-nerved. Floral glumes ovate, acuminate, rounded on the back, faintly nerved. Petals scabrous-ciliate on the keels. Styles obsolete; stigmas hispidulous on all sides, not plumose; ovary deeply sulcate near the apex, sparsely hispidulous; grain beaked and bidentate at the apex.

Hesperochloa Kingii (S. Wats.) Rydb. comb. nov.

Poa (?) *Kingii* S. Wats. Bot. King Exped. 387. 1871.

Festuca confinis Vasey, Bull. Torrey Club **11**: 126. 1884.

Festuca Kingii Scribn. U. S. Dept. Agr. Agrost. Bull. 5: 36. 1897. Not *Festuca Kingiana* (Endl.) Steud. 1855.

Festuca Watsonii Nash, Britt. Man. 148. 1901.

This was originally described as a doubtful *Poa* and afterwards transferred to *Festuca* because the floral glumes are rounded on the back. There are, however, certain characters in the stigmas and the grains that make it fit poorly in either genus. In both *Poa* and *Festuca* the stigmas are plumose, that is, the branches are spreading bilaterally, while in *Hesperochloa* the short bristlelike branches stand out in all directions, a condition rather rare among the grasses.

Hordeum caespitosum Scribn. is found locally throughout the range, *H. montanense* was described from Montana, *H. murinum* and *H. Aegiceras* have been introduced and are locally established especially in Utah.

Sitanion Raf. is a very perplexing genus, and it is very doubtful if the many species proposed by J. G. Smith can be upheld. It is evident that *S. longifolium* and *S. brevifolium* are but local forms of one species, depending on the amount of moisture. As this species is the only one found anywhere near the type locality of

S. elymoides Raf., I think that the latter name should supplant the other two. *S. lanceolatum* J. G. Smith from Montana and *S. marginatum* Scribn. & Merrill from Wyoming are the two species of the range best differentiated and seem to connect the genus with *Elymus*. *S. insulare* was described from northeastern Utah, and *S. ciliatum* has been collected in Wyoming.

ARACEAE

This family is omitted altogether in the New Manual, although *Acorus Calamus* is recorded in my Flora of Colorado and *Lysichiton camtschatcense* (L.) Schott in my Flora of Montana. The former has also been collected in Montana by Butler.

LEMNACEAE

Lemna perpusilla Torr. is included by Nelson in his Manual with the remarks: "Frequent; northern Wyoming to New York." So far as I know this is wholly an eastern species. Specimens so labeled from the Rockies, which have come under my observation, are *L. minor*, *L. minima*, or *L. cyclostasa*, which all have been confused with it.

COMMELINACEAE

Professor Nelson admits two species of *Tradescantia* and gives the following key:

Freely branched; filaments folded; ovary pubescent in riblike lines. 1. *T. laramiensis*.
Simple; filaments straight; ovary pubescent at the apex. 2. *T. occidentalis*.

If these characters hold, as to separating the two species known to Professor Nelson, the second one is not *T. occidentalis*, for the specimen designated by Dr. Britton as the type of *Tradescantia virginica occidentalis*, viz., *Rydberg 1380*, from Thedford, Nebraska, has a branched stem and an ovary pubescent not only at the apex but almost to the base. It is not exactly like the type of *T. laramiensis*, however, for the lateral branches are shorter than the stem proper, the sepals are broader, the leaves broader, and the plant more glandular. In *T. laramiensis* the lateral branches about equal the stem, giving the plant a flat top. If these are specific characters, I do not know. If the two species of the New Manual are distinct, the second one should bear the name *T. universitatis* Cockerell, for it was this form that Professor Cockerell described.

Under the second species is given the following synonym and remark: "(*T. scopulorum* Rose, Contr. U. S. Nat. Herb. **5**: 205. 1899, as to the specimens from Colorado and northward)." This would have been correct if the word "mainly" had been inserted, for I have seen at least one specimen from Colorado that I refer without hesitation to *T. scopulorum*.* The latter differs from the other species of the region by its glabrous or nearly glabrous sepals, its smaller petals, only 10 mm. long, and its subglobose capsule. There is also another species, which should have been included, viz., *T. bracteata* Small, the type of which was from the Black Hills.

MELANTHACEAE

Tofieldia occidentalis S. Wats. has been collected in Idaho; *T. coccinea* Richards. in the Canadian Rockies; *Stenanthella occidentalis* and *Veratrum Eschscholtzianum* in Montana and Idaho.

To me both *Zygadenus dilatatus* Greene and *Z. alpinus* Blankinship seem to be but synonyms of *Z. elegans* Pursh or *Anticlea elegans* Rydb. *Anticlea porrifolia* (Greene) Rydberg (*Zygadenus porrifolius* Greene) was collected last summer in southeastern Utah. So also an undescribed species:

Anticlea vaginata sp. nov.

Perennial, growing in big clumps; cormlike rootstock fully 2 cm. thick; stem 7–10 dm. high, at the base covered with numerous scarious sheaths; leaf blades linear, 3–7 dm. long, 6–10 mm. wide, with numerous veins; inflorescence paniculate, branched; lower bracts linear or subulate, 3–6 cm. long, green, the upper ones ovate, 5–10 mm. long, white; pedicels 5–10 mm. long, often recurved; petals and sepals white, elliptic, obtuse, 7–8 mm. long, usually 7-nerved, the former sometimes a little longer than the latter; filaments linear-subulate, broad at the base, white, slightly shorter than the sepals; anthers nearly round; styles slightly exceeding the perianth, curved.

This differs from the other species of *Anticlea* in its habit of growing in big clumps, and in its numerous loose sheaths at the base of the stem. In the perianth segments it resembles *A. coloradensis*, and *A. porrifolia* in the few veins, the segments are smaller than in the former and broader than in the latter. It resembles

* Garrett and myself collected it also in southeastern Utah last summer.

also *A. porrifolia* in the branched inflorescence but has shorter pedicels and broader leaves. *A. vaginata* grew in loose rich soil under overhanging canyon walls.

UTAH: Armstrong Canyon, near the Natural Bridges, August 4–6, 1911, *Rydberg & Garrett 9407* (type in herb. N. Y. Bot. Gard.).

Professor Nelson gives *Zygadenus gramineus* Rydb. as a synonym of *Z. venenosus* S. Wats. It is evidently *Z. gramineus* he described, although some modification was made. *Z. venenosus* is not found in Wyoming, the most eastern stations known are in the Snake River Valley of western Idaho. It is characterized by the long-clawed petals and sepals and the thick gland. Professor Piper, some years ago, criticized me for redescribing *Z. venenosus*. I think he referred to *Z. intermedius* Rydb. After some arguments on both sides he said that he would look up Watson's type. I do not know that he did, but evidently he came to the same conclusion as I, for in his Flora of Washington* he limited the range of *Z. venenosus* to "British Columbia to California" and hence excluded the Rockies. I have also been criticized for the same thing by Mr. M. E. Jones. Mr. Jones† remarked: "Part of his type of *Zygadenus intermedius* is my No. 2091 from Farmington, Utah. These specimens have no distinct sheath to any of the leaves, except the basal ones. . . . This is a fair sample of Rydberg's accuracy in dealing with *Zygadenus*. . . ." Turning to my original paper,‡ one may see that *J. H. Sandberg 10564* is expressly designated as the type and not *Jones 2091*, which I included in the species. I do not know what Mr. Jones' own specimens show, but there are two of Jones' specimens from Farmington distributed under the number *2091* in the Columbia University herbarium and in these even the upper leaves show short sheaths. One leaf attached near the middle of the stem shows a sheath 1.5 cm. long. I do not think that the presence or absence of a sheath on the upper part is a specific character, but this as well as the citing of a wrong type shows that Mr. Jones is not more accurate than I am.

For my part, I think that *Z. gramineus* can not be upheld as a

* Contr. U. S. Nat. Herb. **11**: 198. 1906.

† Contr. West. Bot. **12**: 77. 26 Mr 1908.

‡ Bull. Torrey Club **27**: 536. 1900.

species distinct from *Z. intermedius*, being a dry hill state of the same with smaller flowers and narrower leaves. *Z. falcatus* Rydb., which Nelson reduced to a synonym, I think is perfectly distinct and nearer related to *Z. paniculatus*. It is what has been known as *Z. Nuttallii* from Colorado. The latter is not found in the range and should have been excluded.

I have here used the name *Zygadenus*, as the species were first described under that name. I have shown that this name belongs to *Z. glaberrimus* and that the plants here discussed should be known as *Toxicoscordion*.

JUNCACEAE

The following species of *Juncus* are found in the Rockies: *Juncus uncialis* Greene, *J. Jonesii* Rydb., *J. Regelii* Buch., *J. Tracyi* Rydb., and *J. mexicanus* in Utah; *J. columbianus* Coville and *J. Regelii* Buch. in Montana; and *J. arizonicus* in Colorado. Professor Nelson includes Colorado in the range of *J. ensifolius* Wikstr. I have seen no specimens of it from that state. The best character, beside the difference in the number of stamens, by which one can distinguish this from *J. saximontanus*, is that the scarious margin of the leaf sheaths in the latter ends in a small auricle, while in *J. ensifolius* the margin gradually diminishes and disappears in the blade.

ALLIACEAE

DIPTEROSTEMON gen. nov.

Plants with fibrous-coated bulbs, few basal elongated narrow leaves and naked scapes. Flowers in subcapitate umbels; bracts 3–5, membranous, colored, usually purple; perianth funnelform or campanulate, purple; segments united about half their length; lobes elliptic, ascending; stamens six; filaments subulate, adnate to the tube, becoming distinct at the throat; those opposite the sepals naked: those opposite the petals at the base with two lanceolate wings or lobes, surpassing the anthers; anthers basifixed; capsule ovate, 3-locular; cells many-seeded.

Some of the species formerly included in *Brodiaea* and lately in *Dichelostemma* differ from the rest enough, I think, to deserve generic rank. The type of *Brodiaea* is *B. grandiflora* Smith. This is the same as *Hookera coronaria* Salisb., published a few months earlier. As the latter is the type of *Hookera*, *Brodiaea* becomes a pure synonym. Dr. Greene,* who was the first to segregate into genera the members of *Brodiaea* taken in the sense of Dr. Watson, retains both genera. Evidently he regarded Smith's second species, *Brodiaea congesta*, as the type. This can scarcely be done, as *B. grandiflora* is not only the first species, but it is more extensively described and discussed. Greene himself afterwards discarded *Brodiaea* and adopted *Dichelostemma*, proposed by Kunth on *Brodiaea congesta* Smith. Alphonso Wood had extended Kunth's genus to include also *B. capitata* Benth. and *B. volubilis* Baker (*Stropholirion californicum* Torr.). Wood was followed by Greene in including these species in the genus. *Stropholirion* has been generally recognized as a genus, even by S. Watson. The typical species of *Dichelostemma*, i. e., *D. congesta* (Smith) Kunth and its relative *D. multiflora* (Benth.) Heller, have only 3 stamens alternating with 3 staminodia and differ from the typical species of *Hookera* only in the rounded base of the perianth and the subcapitate inflorescence. If they are kept distinct then *Seubertia* should be regarded distinct from *Triteleia*. *Brodiaea capitata* has 6 fertile stamens with subulate filaments. At the base of each of the inner three there are two lanceolate lobes partly adnate to the perianth, forming together a crown of 6 instead of 3 members. To the new genus proposed here, belong:

Dipterostemon capitatus (Benth.)

Brodiaea capitata Benth. Pl. Hartw. 339. 1857.

Dipterostemon pauciflorus (Torr.)

Brodiaea capitata pauciflora Torr. Bot. Mex. Bound. Surv. 218. 1859.

Dipterostemon insularis (Greene)

Brodiaea insularis Greene, Bull. Calif. Acad. Sci. **2**: 134. 1887.

Dipterostemon pulchellus (Salisb.)

Hookera pulchella Salisb. Parad. **2**: *pl. 117.* 1808.

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* Bull. Calif. Acad. Sci. 2: 125–144. 1886.

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THE GENUS STRUTHIOPTERIS AND ITS REPRESENTATIVES IN NORTH AMERICA

By JEAN BROADHURST

NEW YORK
1912

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[From the Bulletin of the Torrey Botanical Club, 39: 257–278, *pls.* 21–22. 10 Jy 1912.]

The genus Struthiopteris and its representatives in North America—I*

Jean Broadhurst

(With plates 21, 22)

Struthiopteris is here used for Willdenow's genus *Lomaria*, which was published first in 1809. It includes also Robert Brown's genus *Stegania* published in 1810. Christensen† reduces *Lomaria* (including *Stegania*) to a subgenus of *Blechnum* and in this subgenus recognizes one hundred species. Including the two North American species placed under *Lomaria* by Willdenow, thirty-six species have been described from North America under the generic name *Lomaria;* this does not include the species since placed in the genera *Stenochlaena*, *Salpichlaena*, and *Plagiogyra*. Twenty-five North American species are recognized by the writer; of these five are new and one must bear a new name.

Though not included by Linnaeus in his Species Plantarum, the genus *Struthiopteris* is much older than 1753. Trevisan‡ gives 1561 for the earliest use of this name and cites Valerius Cordus§ as using *Struthiopteris* to distinguish *Osmunda Spicant* L. It was later used in this sense by several others. The most prominent was probably Haller;‖ in 1742 he used the monomial *Struthiopteris*, citing *Struthiopteris* of Cordus.

Soon after 1753 the generic name *Struthiopteris* was used for

* Based upon a preliminary report which was submitted in partial fulfilment of the requirements for the Degree of Master of Arts in the Faculty of Pure Science, Columbia University.

† Ind. Fil. 150–161. 1905.

‡ Atti Ist. Ven. III. **14**: 553–588. 1869.

§ Hist. Pl. **2**: 170. 1561.

‖ Enum. Stirp. Helv. 132. 1742.

Osmunda Spicant L. by Scopoli, Haller, and Weis. In 1760 Scopoli* used the monomial *Struthiopteris*, and included under it number 844 of Linnaeus;† this species Linnaeus‡ had meanwhile named *Osmunda Spicant*. Therefore, by citation, the correct name of this genus is *Struthiopteris* (Hall.) Scop.

Haller,§ in 1768, again used the monomial *Struthiopteris*, referred to Scopoli's work of 1760, and cited, by number, *Osmunda Spicant* of Linnaeus. The first, however, to publish a binomial under *Struthiopteris* was Weis,‖ who in 1770 (two years before Scopoli¶) published *Struthiopteris Spicant*. The correct name for the type species of this genus is therefore *S. Spicant* (L.) Weis. Willdenow,** in 1787, referred to *Struthiopteris Spicant* Weis as a synonym of *Osmunda Spicant*. Swartz†† later included *Struthiopteris* in a list of generic synonyms for this species. Neither Swartz, however, nor Willdenow adopted it.

In the first decade of the nineteenth century four writers, Bernhardi, Robert Brown, Swartz, and Willdenow, each added somewhat to the confusion regarding the correct name of this genus. Bernhardi‡‡ published a similar name, *Struthopteris*, for three other ferns of the Linnaean genus *Osmunda* (*O. cinnamomea*, *O. Claytoniana*, and *O. regalis*) with the caution that it was not to be confounded with *Struthiopteris* Hall. Willdenow§§ published *Struthiopteris* for *Osmunda Struthiopteris* L. and an undescribed "*Struthiopteris* from Pennsylvania" (which he described in 1810 as *S. pennsylvanica*). Three of these workers transferred *Osmunda Spicant* L., the type of the genus *Struthiopteris*, to other established genera: Bernhardi‖‖ to *Asplenium*, Willdenow ¶¶ to *Acrostichum*, and Swartz *** to *Blechnum*. Swartz †††also placed several

* Fl. Carn. 168. 1760.

† Fl. Suec. 307. 1745.

‡ Sp. Pl. 1066. 1753; Fl. Suec. 370. 1755.

§ Hist. Stirp. Helv. **3**: 6. 1768.

‖ Pl. Crypt. Fl. Gott. 286. 1770.

¶ Fl. Carn. **2**: 288. 1772.

** Prod. Fl. Berol. 289. 1787.

†† Under *Blechnum boreale;* Syn. Fil. 115. 1806.

‡‡ Jour. Bot. Schrad. **1800**²: 126. 1801.

§§ Ges. Nat. Fr. Berl. Mag. **3**: 160. 1809.

‖‖ Jour. Bot. Schrad. **1799**¹: 309. 1799.

¶¶ Prod. Fl. Berol. 289. 1787.

*** Syn. Fil. 115. 1806.

††† Prod. 127. 1788; Fl. Ind. Occ. **3**: 1583–1586, 2010. 1806.

related species first in *Osmunda* and later (following Hoffman*) in *Onoclea*. Later Willdenow and Brown each published new generic names for part of the genus under discussion. Willdenow,† in 1809, published the genus *Lomaria*, citing all of *Onoclea* of Swartz except *O. sorbifolia* as the basis of the name; and in the following year Willdenow‡ listed under *Lomaria* most of Swartz's species of *Onoclea*. In 1810 Robert Brown§ published *Stegania*, before mentioned, for eight African members of this genus. In so doing he separated *Spicant* from its relatives, just as Swartz had done when he placed it under *Blechnum*, and its relatives under *Osmunda* and later *Onoclea*.

This confusion has continued even to the present, although two authorities, Trevisan‖ and Underwood,¶ have shown independently (1) that *Osmunda Spicant* L. has "first claim to *Struthiopteris*, becoming *Struthiopteris Spicant*," and (2) that the correct generic name for *Osmunda Struthiopteris* L. is not *Struthiopteris* but *Matteuccia*, established by Todaro** in 1866.

Trevisan attempted to divide the genus *Struthiopteris*, recognizing *Lomaria* Willd. for part of it. In his key he describes *Struthiopteris* as having median sori and ascribes marginal sori to *Lomaria*. Trevisan discusses but three of the North American species, *Spicant*, *doodioides*, and *polypodioides*, which he places under *Struthiopteris*. A careful examination of the North American material in the New York Botanical Garden herbarium does not justify this division. The term "median" is not applicable, even relatively, to the indusium in any of this material; the sterile extension outside the indusium may be perceptibly wider in the young leaves, but the conditions in the mature fronds do not justify the use of the term. Nor do *S. Spicant* and *S. polypodioides* differ from any of the other species in the relative position of the indusium.

* Deutsch. Fl. **2**: 12. 1795.

† Ges. Nat. Fr. Berl. Mag. **3**: 160. 1809.

‡ Sp. Pl. **5**: 289. 1810.

§ Prod. Fl. Nov. Holl. 152. 1810.

‖ Atti Ist. Ven. III. **14**: 556. 1869.

¶ Mem. Torrey Club **6**: 257. 1899.

** Giorn. Sci. Nat. **1**: 208–254. 1866. Todaro also recognized the priority of *Struthiopteris Spicant* for *Osmunda Spicant* L.

Other possible divisions of this large genus, based upon characters offered by the sterile fronds, the indusium, and the sporangia and spores, have been considered by the writer and found unsatisfactory for the following reasons: (1) The variations in the sterile leaves in proportion, cutting, and texture depend greatly upon the age of the leaf and of the plant; (2) in the fertile leaves the indusium remains entire in the pinnatifid species, and though it usually becomes lacerate or fimbriate in the pinnate species, these show all degrees of laceration; (3) a careful microscopic study of the spores and sporangia, which Fée apparently considered important, reveals no constant differences in the North American species.

The greatest variation is undoubtedly in the habit, for the North American species include: (1) Tree-climbing forms with pendent leaves, (2) terrestrial, cespitose forms, (3) terrestrial, inclined or erect forms with stems 5–45 cm. long, and (4) subarboreous forms with stems at least 20 cm. high and 12 cm. thick. These differences we are at present unable to correlate with any other character. The habits of some species are not definitely known, because collectors have so often brought back incomplete specimens without field notes; mention of the habit is rarely included in the original description; and further, even American writers have confused our own species with the descriptions of African and other foreign ones and attributed to them characters they never possess. In making the key for this genus, habit has therefore been almost ignored; the key is strictly artificial and based mainly upon the frond characters rather than upon those of the whole plant.

The following key and descriptions have been based chiefly upon the specimens in the herbaria of the New York Botanical Garden and the United States National Museum. Begun under the direction of Professor Lucien M. Underwood, this paper has been completed with assistance from Mr. William R. Maxon and Dr. Ralph C. Benedict. Dr. H. Christ and Dr. B. P. G. Hochreutiner also kindly sent tracings or material from their herbaria. Access was freely given to the herbaria at Geneva and Kew.

STRUTHIOPTERIS (Hall.) Scop.

Fronds dimorphous (otherwise resembling *Blechnum*), usually pinnatifid or once pinnate; veins free, simple or usually once forked, usually not reaching the margin; sori linear and intramarginal (not costal as in *Blechnum*); indusium intramarginal in attachment,* at maturity opening toward the midrib, and then either (1) entire and not reflexed or (2) more or less lacerate or fimbriate and reflexed.

Key to the non-petioled species †

A. STERILE PINNAE NEVER PETIOLED, THE WHOLLY ADNATE BASE THE WIDEST PART OF THE PINNA; RHIZOME SCALES NEVER RIGID; PINNAE LACKING SCALES; INDUSIUM NOT LACERATE WITH AGE

Plants epiphytic; rhizome wide-creeping; rhizome scales and basal stipe scales usually with a black median line (wholly lacking in *S. Plumieri*); stipes scattered, the fertile ones straw-colored or bicolored with dull brown or blackish; mature lamina not punctate by transmitted light; fertile pinnae not conspicuously dilated at their bases.

Lamina broadly oblong, very abruptly reduced at the base (type A,‡ with vestigial pinnae); pinnae 22–28-jugate, 16–18 cm. long, straight or nearly so, the middle ones always straight. 1. *S. ensiformis.*

Lamina linear or very narrowly oblong to broadly lanceolate, gradually to abruptly reduced at the base (type G to D, with vestigial pinnae in D only); pinnae 25–75-jugate, 2.5–16 cm. long, slightly curved to falcate, the middle ones always falcate.

Rhizome scales usually with a black median line; lamina linear, narrowly oblong, or lanceolate, 4–17 times as long as broad, usually very gradually reduced at the base (type G to F, rarely E); leaf tissue rigid-herbaceous; pinnae usually contiguous. 7. *S. polypodioides.*

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* The intramarginal character of the indusium is obscured in many of the pinnate species by the thickened edges of the pinnae, due to the more or less glandular thickening of the vein apices. In the sterile pinnae these thickenings may result in dark spots, slight swellings, circular cartilaginous areas or depressions, or occasionally in more or less detachable scalelike elevations.

† The species having petioled sterile pinnae will be discussed in a later number of the BULLETIN OF THE TORREY BOTANICAL CLUB. The sterile fronds of the non-petioled species are cut to the rachis, but the bases of the pinnae are wholly adnate, and except in a few specimens of *S. ensiformis*, the base is always the widest part of the pinna. Fée and others classify these as pinnatifid. Petiole instead of petiolule is used throughout when referring to the pinnae.

‡ See FIGURE 1, which gives several diagrams illustrating the variation in the bases of the laminae.

Rhizome scales never with a black median line; lamina broadly lanceolate to lanceolate, 2.5–4.5 times as long as broad, usually abruptly reduced below (type D to E, with vestigial pinnae); leaf tissue membranous to herbaceous; pinnae distant in the basal half to third of the lamina. 6. *S. Plumieri.*

Plants terrestrial; rhizome inclined to erect; rhizome scales and basal stipe scales never with a black median line; stipes clustered at the apex of the rhizome, the fertile ones partly, or oftener wholly, shining chestnut to black; mature lamina fully punctate by transmitted light (see *S. Spicant* for exceptions); fertile pinnae conspicuously dilated at their bases (except in *S. Maxonii*).

Sterile lamina gradually reduced at the base (type F–G, without vestigial pinnae); vein spaces 8–15 to 1 cm.

Rhizome erect (43 cm. high, in type); vein spaces 8–10 to 1 cm.; fertile pinnae not dilated at their bases. 5. *S. Maxonii.*

Rhizome creeping or stoloniferous; vein spaces 10–15 to 1 cm.; fertile pinnae conspicuously dilated at their bases.

Sterile fronds of two types in texture and position, 20–70 cm. long; rhizome apparently not stoloniferous; pinnae 36–80-jugate, 3–15 times as long as wide. 8. *S. Spicant.*

Sterile fronds similar in texture at least, 11–20 cm. long; rhizome stoloniferous; pinnae 16–22-jugate, 1–3 times as long as wide. 9. *S. stolonifera.*

Sterile lamina abruptly reduced at the base (type B–D, with vestigial pinnae except in *S. L'Herminieri*); vein spaces 6–8 to 1 cm.

Stipes (of the sterile fronds, at least) without scarlike vestigial pinnae; lamina lanceolate, 5–11 cm. wide; pinnae mainly falcate, ascending. 4. *S. L'Herminieri.*

Stipes with vestigial pinnae; lamina elliptical, ovate-lanceolate, oblong-deltoid, or deltoid, 12–32 cm. wide; pinnae mainly straight, diverging.

Lamina of mature fronds deltoid to oblong-deltoid, or ovate-lanceolate and very abruptly reduced below (type A or B); lower pinnae contiguous, if shorter abruptly reduced to semicircular lobes; sporophyls fertile on the dilated bases of the pinnae. 2. *S. exaltata.*

Lamina of mature fronds broadly elliptical, less abruptly reduced below (type D); lower pinnae distant or appearing so, always shorter; sporophyls not fertile on the dilated bases of the pinnae. 3. *S. jamaicensis.*

1. S. ENSIFORMIS (Liebm.) Broadh.; Maxon, Contr. U. S. Nat. Herb. **13**: 17. 1909.

Lomaria ensiformis Liebm. Vid. Selsk. Skr. V. 1: 82. 1849.
Blechnum ensiforme C. Chr. Ind. Fil. 153. 1905.

Plants epiphytic. Rhizome creeping, 5–7 cm. long in fragments seen, the scales linear, 5–10 mm. long, maroon to tobacco brown, with a black median line. Sterile fronds 90–100 cm. long; stipes scattered, 20–28 cm. long, channeled on the upper side,* not angulate, marked about halfway down by scarlike undeveloped pinnae, bicolored, the darker side dark chocolate brown, the deciduous basal stipe scales† smaller than the scales of the rhizome; lamina 40–68 cm. long, 25–35 cm. wide, broadly oblong, abruptly reduced at the base (type A, but with vestigial pinnae as described above), the apex gradually reduced, the terminal pinna 5–8 cm. long, the pinnae more or less opposite, the lower ones distant, sometimes 2–3 cm. apart; pinnae 22–28-jugate, narrowly oblong to linear, straight, not falcate (if curved, only near the apex), horizontal or ascending, 16–18 cm. long, 12–17 mm. wide,‡ long-acuminate, the base dilated in the upper pinnae, in the lower ones occasionally slightly contracted; margins entire (or barely subentire near the apex, not definitely serrate), not at all or very slightly revolute; leaf tissue rigid-herbaceous, without scales; veins not conspicuous, usually sunken on the under side, the vein apices with very slight swellings or depressions, the vein spaces 10–13 to 1 cm. Sporophyls 60–70 cm. long; stipes§ 20–28 cm. long, straw-colored or bicolored; lamina 32–45 cm. long, gradually reduced toward the apex, the terminal pinna 5–10 cm. long; pinnae 20–30-jugate, 10–20 cm. long, 3–4 mm. wide, with a sterile tip 3–6 mm. long, the base contracted (occasionally dilated below the contraction); indusium rather heavy, entire, not becoming lacerate; sporangia dark brown.

TYPE LOCALITY: Oaxaca, Mexico.

DISTRIBUTION: Mexico, Guatemala, Costa Rica, and Panama.

SPECIMENS INCLUDED: GUATEMALA: Baja Verapaz, "Hochwald bei Purulha," altitude 1,800 m., *von Türckheim 1693* (Y, N).‖

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* In all of the species included in this paper the rachis and stipe are channeled on the upper (ventral) side; that statement is not, therefore, repeated in the following descriptions.

† Unless otherwise described in the following species, the basal stipe scales are shorter and more deciduous than the rhizome scales but similar in color and texture.

‡ Throughout this paper the measurements of the pinnae are those of the largest lateral ones; the width is measured at the adnate base of the non-petioled pinnae.

§ Vestigial pinnae, scales, etc., as in the sterile stipes. This likeness will be understood hereafter, unless they are described separately.

‖ N indicates that the specimen cited is in the United States National Herbarium; Y, in the herbarium of the New York Botanical Garden.

Alta Verapaz, "Waldungen," Pansamala between S. Pedro Cariha and Senahu, altitude 3,800 ft., *von Türckheim 640* (N). Alta Verapaz, near the Finca Sepacuite, *Cook & Griggs 417* and *420* (N).

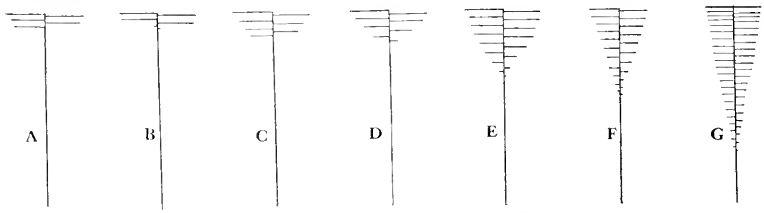

FIGURE 1. Types of frond bases found in the North American species of *Struthiopteris*.

The adnate dilated bases mentioned by Liebmann are most characteristic of the specimens mentioned above; though no Mexican specimens have been seen, Liebmann's full description leaves no doubt that the Guatemalan specimens belong to this species.

The Costa Rican and Panama specimens examined differ in being more gradually reduced at the base (type C), in having proportionately broader pinnae which are more abruptly acuminate, and in having shorter lower pinnae (4–6 cm. long) which are more contracted at the base and farther apart (2–4 cm.). The three Costa Rican specimens, *Pittier 10176* ("Forêts de la Palma," Pacific slopes) and U. S. National Herbarium no. 575237 and no. 575239 (both the latter without definite locality, collected by Wercklé, 1901–1905) are in these respects intermediate between the Guatemalan plants and the one from Panama, *Maxon 5526* (humid forests of Cuesta de Las Palmas, southern slope of Cerro de la Horqueta, Chiriqui, altitude 1,700–2,100 m.). Since Pittier's no. 10176 is the only one with a fertile frond it does not seem best to separate these more southern plants at present.

2. **S. exaltata** (Fée) Broadh. comb. nov.

Lomaria exaltata Fée, Mém. Foug. **11**: 10. *pl. 3*. 1866.

Plant terrestrial. Rhizome erect or ascending, 4–40 cm. long, the scales lanceolate to ovate-lanceolate, about 1 cm. long, 2–2.5 mm. wide, tobacco brown. Sterile fronds 30–90 cm. long; stipes 20–30 cm. long, slightly to decidedly angulate, marked usually throughout with vestigial pinnae varying from mere scars to lines about 1 cm. long, bicolored; lamina 22–47 cm. long, 12–24 cm. wide, deltoid to oblong-deltoid or ovate-lanceolate, the base abruptly reduced (type A or B, with vestigial pinnae), with or without 1–3 more or less semicircular contiguous lobes, gradually reduced at the apex, the terminal pinna 5–9 cm. long, the pinnae usually alternate, the lower more or less diverging but contiguous; pinnae 9–18-jugate, broadly triangular to oblong, straight (or the upper ones slightly curved), the apex acute, never acuminate, sometimes contracted near but not at their bases, 6–12 cm. long, 1.5–3 cm. wide; margins entire, not at all or but irregularly and slightly revolute; leaf tissue rigid-herbaceous, closely and markedly punctate, showing throughout rounded translucent spaces when held to the light, without scales; veins rarely conspicuous, never raised or grooved, usually ending in circular glandular swellings or in depressions which occasionally hold a more or less separable, central, scalelike swelling, the vein spaces 6–7 to 1 cm. Sporophyls 44–90 cm. long, taller than the sterile in all the complete specimens seen; stipes 24–40 cm. long, marked with vestigial pinnae, usually reddish brown, occasionally purplish black, not bicolored as in the sterile, though sometimes lighter on the upper side; lamina 22–40 cm. long, abruptly reduced at the base, gradually at the apex, the terminal pinna 5–10 cm. long; pinnae 12–22-jugate, 11–14 cm. long, 3–4 mm. wide, often with a sterile tip 3–7 mm. long, broadly dilated both ways at the base and fruited on the dilations; indusium not heavy, entire, not becoming lacerate; sporangia varying from yellow to dark brown.

TYPE: Fée, Mém. Foug. **11**: *pl. 3.* 1866. Collected by L'Herminier in 1861, Guadeloupe.

DISTRIBUTION: Jamaica, Porto Rico, the Lesser Antilles (St. Kitts, Montserrat, Guadeloupe, Dominica, and Martinique), Costa Rica, and Panama.

SPECIMENS INCLUDED: PORTO RICO: Luquillo Mountains, *Wilson 135* (Y). ST. KITTS: Top of Mt. Misery, under cliff, *Britton & Cowell 546* (Y). MONTSERRAT: Chance's Mountain, at the top, altitude 3,000 ft., *Shafer 273*. GUADELOUPE: *Duss 4167.4166*,* (Y, N). DOMINICA: Mt. Diablotin, *Lloyd 880* (Y) and *893* (Y, N).

This has been confused by Jenman and by some European

* Often the localities given on the Duss sheets are descriptive rather than specific: different localities are given for sheets bearing the same collection number, or several localities are given on one sheet. The locality is, therefore, omitted in such cases.

writers with *Lomaria Plumieri* Desv. The broad, horizontal pinnae pictured in the type of *exaltata* separate it positively from *Plumieri* with its narrow, falcate pinnae, pictured by Plumier. *L. mucronata*, which Christensen refers to *Plumieri*, is much nearer *exaltata*. Fée, in this, as in several other original descriptions, makes contradictory statements regarding the size. This mistake led to two others: (1) the publication of *L. Féei* as a distinct species; and (2) the placing of *L. exaltata* under *L. L'Herminieri* as a variety. Christensen includes *exaltata* in *L'Herminieri;* although the immature sterile laminae of *exaltata* sometimes resemble the mature ones of *L'Herminieri* in proportion and in the shape of the pinnae, they seem otherwise distinct.

Four sheets from Grenada, collected by Sherring (October to May, 1890–91) show young specimens, which are more delicate in texture and bear pinnae which are shorter and more like those of *L'Herminieri*. The basal reduced pinnae are prominent, more numerous, and contiguous. They are accompanied by taller but immature fertile fronds; no mature sterile or fertile fronds from the island have been seen. At present it seems best to leave these Sherring specimens in *S. exaltata*.

Three sheets from Costa Rica ("Forêts de l'Achiote, Volcan de Poas," altitude 2,000 m., *Tonduz 10709*) have laminae with wider sinuses, and occasionally 2 or 3 pairs of semicircular lobes at the base. The pinnae are proportionately as well as actually narrower, and the fronds have an open appearance not really characteristic of the species. Christ named them *L. L'Herminieri*, but they seem much nearer *exaltata*, especially in the shape of the lamina and of the pinnae. Maxon's no. 5671 (humid forests of the upper Caldera watershed, between "Camp I" and the Divide, Holcomb's trail, above El Boquete, Chiriqui, altitude 1,650–1,925 m.) has pinnae which are more curved; Maxon's no. 5427 from the same region (humid forest around Los Siguas Camp, southern slope of Cerro de la Horqueta, Chiriqui, altitude about 1,700 m.) has wider sinuses in the lower part of the lamina, and the vestigial pinnae are much more prominent than in the other specimens seen.

3. **S. jamaicensis** Broadh. sp. nov.

Plant terrestrial. Rhizome ascending, 24 cm. long (in the one complete specimen seen), 2–3 cm. thick; the scales very scanty, ovate-lanceolate, about 1 cm. long, tobacco brown. Sterile fronds 80–100 cm. long; stipes numerous, close, 27–45 cm. long, usually somewhat angulate, marked throughout with vestigial pinnae, which vary from mere scars to wide but very short lobes, chestnut to reddish purple and black, light colored in the channel, scales usually lacking; lamina 60–80 cm. long, 20–32 cm. wide, elliptical, rather abruptly reduced at the base (type D, with vestigial pinnae), the lower pinnae more or less distant (1 cm.), gradually reduced at the apex, the terminal pinna 3–8 cm. long, rachis light colored on the upper side; pinnae 18–35-jugate, the upper curved or falcate, the lower less curved to straight and oblong, the apex attenuate, the base broadly dilated, especially in the lower pinnae, which are 10–16 cm. long, 1–2 cm. wide (the lowest ones 3–6 cm. long and 2.5–3.5 cm. wide at their bases); margins entire, unevenly or not at all revolute; leaf tissue membranous to herbaceous, punctate as in *S. exaltata*, without scales; veins distinct, never raised nor grooved, the apices glandular as in *exaltata*, vein spaces 6–8 to 1 cm. Sporophyls 88 cm. long (in the only complete one seen); stipes 30–40 cm. long, lighter than the sterile, the vestigial pinnae less prominent; lamina 45–52 cm. long, abruptly reduced at the base, the apex gradually reduced; pinnae 24–30-jugate, 10–15 cm. long, 3–4 mm. wide, the apex with a sterile tip 1–5 mm. long, the base dilated; indusium entire, not becoming lacerate; sporangia greenish yellow in fresh specimens. [PLATE 21.]

Type in the U. S. National Herbarium, no. 429499 and 429500, and in the New York Botanical Garden, collected near a stream in a wet ravine, forest near Hardware Gap, Jamaica, altitude 4,200 feet, *William Harris 10099*, February 19, 1908.

The type collected in 1908 has made possible the separation from *S. exaltata* of several incomplete specimens in the herbaria at Geneva and New York. *S. jamaicensis* differs from *S. exaltata* in being thinner in texture, widest at the middle, and in having more numerous pinnae with acuminate tips; it differs also in having lower pinnae which are much more dilated at the base, and which, if not separated, appear so because of the flaring sinuses; the fertile pinnae are evidently not soriated on the dilations as in *S. exaltata*.

4. **S. L'Herminieri** (Bory) Broadh. comb. nov.

Lomaria L'Herminieri Bory; Kunze, Farrnkr. 173. *pl. 73*. 1845.

Lomaridium Herminieri Presl, Epim. Bot. 263. 1851.

Spicanta L'Herminieri O. Kuntze, Rev. Gen. Pl. **2**: 820. 1891.
Blechnum L'Herminieri C. Chr. Ind. Fil. 156. 1905.

Plants terrestrial. Rhizome ascending to erect, at least 4–15 cm. high, the scales not numerous, lanceolate to ovate-lanceolate, tobacco brown. Sterile fronds 30–48 cm. long; stipes 4–12 cm. long, not at all or somewhat angulate, without vestigial pinnae, bicolored; lamina 18–32 cm. long, 5–11 cm. wide, lanceolate, abruptly reduced at the base (type A or B), usually with 2 or more pairs of somewhat semicircular, contiguous lobes at the base, gradually reduced at the apex, with a terminal pinna 2–6 cm. long, the pinnae sometimes opposite; pinnae 7–16-jugate, the upper ones falcate, the lower ones more or less falcate, the apex acute, never acuminate, the base more or less dilated, 3.5–6 cm. long, 10–18 mm. wide; margins entire, slightly and only irregularly revolute; leaf tissue rigid-herbaceous, without scales; veins distinct, not definitely raised or grooved, the apices somewhat glandular, the vein spaces 6–8 to 1 cm. Sporophyls 26–50 cm. long, and often but little taller than the accompanying sterile fronds; stipes 13–35 cm. long, straw-colored to brownish, occasionally slightly purplish, but slightly or not at all marked with vestigial pinnae in the upper part; lamina 13–24 cm. long, abruptly reduced at the base, gradually reduced at the apex; pinnae 10–17-jugate, 4–9 cm. long, 2–3 mm. wide, with or without a constricted sterile tip, the base widely dilated, not fruited on the dilations; indusium not heavy, entire, not becoming lacerate; sporangia dark brown.

TYPE: *Bory 201*, from Guadeloupe (Kunze also cites *Linden 193* and *Moritz 31*, both from Caracas).

DISTRIBUTION: Known from Guadeloupe, Martinique, and Dominica.

SPECIMENS INCLUDED: GUADELOUPE: *Duss 4166* (Y, N); *Duss 4167* (N). DOMINICA: Mt. Diablotin, *Lloyd 885* (N). MARTINIQUE: *Duss 1554* (Y).

5. **S. Maxonii** Broadh. sp. nov.

Plants terrestrial. Rhizome erect, 43 cm. high (in type specimen), the scales numerous at the apex, linear to lanceolate, 5–10 mm. long, purplish brown to black. Sterile fronds 25–38 cm. long; stipes 3–6 cm. long, not at all or but slightly angulate, without vestigial pinnae, straw-colored or bicolored with reddish brown or brown, the scales not numerous, very deciduous, ovate to lanceolate, 3–5 mm. long, dull brown; lamina 22–35 cm. long, 3–5 cm. wide, narrowly elliptical, gradually reduced at the base (type F), gradually reduced at the apex, the terminal pinna 1–4 cm. long, the lower pinnae often opposite; pinnae 16–26-jugate, falcate, the apex rounded to subacute, the base somewhat dilated, 2–3 cm. long, 8–12 mm. wide; margins not at all or slightly and irregularly revolute; leaf tissue rigid-herbaceous, punctate as in *S. exaltata*, without scales; veins not distinct, occasionally slightly grooved below, the apices marked with circular glandular areas, vein spaces 8–10 to 1 cm. Sporophyls 25–28 cm. long; stipes 1–5 cm. long, usually bicolored with reddish brown; lamina 14–16 cm. long, abruptly reduced below, gradually reduced above; pinnae 14–18-jugate, 2–3.5 cm. long, 2 mm. wide, with a sterile tip 1–2 mm. long, the base but slightly or not at all dilated; indusium delicate, entire, not becoming lacerate; sporangia yellowish or brownish yellow to brown. [PLATE 22.]

Type in the U. S. National Herbarium, no. 675793 and 675794, collected in humid forests around Los Siguas Camp, southern slope of Cerro de la Horqueta, Chiriqui, altitude about 1,700 meters, *William R. Maxon 5415*, March 17–19, 1911.

SPECIMENS INCLUDED: COSTA RICA: "Barba, borde du Rio Máncaron," altitude 1,200 m., *Pittier & Durand 2001*. U. S. National Herbarium no. 154300, without definite locality and collection number, *Cooper*.

In a cover with some South American plants marked tentatively sp. nov. by Professor L. M. Underwood, are two sheets from Colombia (altitude 5,000 feet, *H. Smith 1084*). One has a rhizome 33 cm. high, and they surely belong in this species.

6. **S. Plumieri** (Desv.) Broadh. comb. nov.

Lomaria Plumieri Desv. Ges. Nat. Fr. Berl. Mag. **5**: 325. 1811.

Lomaria martinicensis Spreng. Neue Entd. **3**: 5. 1822 (cited by Desvaux in 1827 as a synonym).

Lomaridium Plumieri Presl, Epim. Bot. 155. 1851.

Spicanta Plumieri O. Kuntze, Rev. Gen. Pl. **2**: 820. 1891.

Blechnum Plumieri Diels, in E. & P. Nat. Pfl. 1^4: 248. 1899.

Plants epiphytic. Rhizome creeping on rocks and trees, at least 7–12 cm. long, 1–3 cm. thick, the scales numerous, linear, 10–18 mm. long, decidedly reddish brown to burnt umber, without a black median line. Sterile fronds 65–115 cm. long; stipes scattered, 15–27 cm. long, not at all or but slightly angulate, irregularly marked with vestigial pinnae in the upper part, bicolored (uniformly straw-colored in one frond, *Lloyd 898*); lamina 30–90 cm. long, 12–28 cm. wide, lanceolate to ovate-lanceolate, abruptly reduced at the base (type D to E, with vestigial pinnae), gradually reduced at the apex, the terminal pinna 4–7 cm. long, the pinnae usually alternate, distant (1–2 cm.) in the lower third or half of the lamina; pinnae 28–60-jugate, linear, slightly curved to falcate, the apex long-acuminate, the base dilated in the upper part of the lamina, sometimes slightly contracted near the base in the lower pinnae, 7–16 cm. long, about 1 cm. wide (1–2 cm. at the dilated bases); margins entire (apparently subentire in the heavier ones owing to the shrinkage of the tissue between the vein apices); leaf tissue membranous to herbaceous, without scales; veins distinct above in membranous specimens, often appearing below as fine black lines, the glandular apices rather inconspicuous, often blackish, the vein spaces 10–14 to 1 cm. Sporophyls 40–70 cm. long; stipes 12–25 cm. long, with scarlike vestigial pinnae, brownish yellow to dull or purplish brown, or indistinctly bicolored; lamina 18–58 cm. long, abruptly reduced at the base, gradually reduced at the apex; pinnae 20–60-jugate, 7–15 cm. long, 2–4 mm. wide, usually having a sterile tip 1–3 mm. long, the base slightly contracted (sometimes with slight, thin dilations below the contraction); indusium entire, not becoming lacerate, often reflexed; sporangia dark brown.

TYPE: From Martinique, Plumier, Foug. *pl. 90.* 1705.

DISTRIBUTION: Known from Montserrat, Guadeloupe, Dominica, and Martinique.

SPECIMENS INCLUDED: GUADELOUPE: Climbing epiphyte, "Forêts de la Decouverte," *Duss 4168* (Y, N). DOMINICA: Mt. Diablotin, *Lloyd 898* (Y, N). MARTINIQUE: "Mt. de la Calebasse," *Berlanger 814* (Geneva; tracing, Y). Climbing on trees, "Forêts Deux Choux," *Duss 1555* (Y). Climbing on trees, Calebasse, *Duss 4588* (Y).

The four islands furnishing the specimens of *S. Plumieri* studied (23 sheets), lie near the middle of a chain of islands extending from Yucatan to South America. Passing either northwest or south along that chain, we find plants intermediate in character between *S. Plumieri* and the following, more widely distributed species, *S. polypodioides.* Of the few specimens from Grenada, four sheets (*Sherring 146*) are like *S. Plumieri* in the following respects: The rhizome scales lack the black median line; the stipe is marked with vestigial pinnae; the sterile lamina has the base rather abruptly reduced; the pinnae are very long; and the lower pinnae are sometimes distant. They are like *S. polypodioides* in the proportionate length of the lamina and in the more falcate pinnae. The other specimens from Grenada fall unquestionably into *S. polypodioides.*

We find similar intermediate forms in passing northwest from Guadeloupe through Porto Rico. One sheet from Porto Rico (*Hioram 275*, Mt. Torresilla, U. S. National Herbarium no. 657235) has the texture and the base of *S. Plumieri;* the other characters are all those of *S. polypodioides.* The other (5) specimens from Porto Rico are all of the *polypodioides* type except that none of them has black in the rhizome scales. This black median line is also lacking in 4 of the 28 Jamaican sheets of *S. polypodioides,* and occasionally so in specimens from Cuba and Mexico.*

Fée's description and picture of *Lomaria Plumieri* can not be separated from *L. Plumieri* Desv., and Fée himself says that his figure is given to "complete" Plumier's figure. Jenman nevertheless confused *Plumieri* with *exaltata,* thus (1) making his description of the habit of *Plumieri* untrue, and (2) leading to the establishment of *Féei* for what he mistakenly considered Fée's *Plumieri,* the raised-veined form of *polypodioides.* Christensen gives *Lomaria divergens* Kze. and *L. mucronata* Fée both as synonyms for *Plumieri.* Neither is synonymous, for *L. divergens* has pinnae with wedge-shaped bases, and *L. mucronata* is much like *exaltata* in the cutting and the proportions of the lamina and the pinnae.

7. S. POLYPODIOIDES (Sw.) Trev. Atti Ist. Ven. III. **14**: 571. 1869.

Osmunda polypodioides Sw. Prod. 127. 1788.

Blechnum onocleoides Sw. Jour. Bot. Schrad. **1800**²: 75. 1801.

Onoclea polypodioides Sw. Fl. Ind. Occ. **3**: 1585. 1806.

Lomaria polypodioides Desv. Prod. 288. 1827.

Lomaria onocleoides Spreng. Syst. **4**: 62. 1827.

Lomaria fragilis Liebm. Vid. Selsk. Skr. V. **1**: 80. 1849.

Spicanta onocleoides Presl, Epim. Bot. 114. 1851.

Lomaria decrescens Fée, Gen. Fil. 68. 1852; Mém. Foug. **7**: 24. *pl. 9, f. 1.* 1857.

Lomaria mexicana Fée, Mém. Foug. **8**: 70. 1857.

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* See also the discussion under *S. polypodioides.*

Blechnum polypodioides Kuhn, Fil. Afr. 92. 1868.
Spicanta polypodioides O. Kuntze, Rev. Gen. Pl. **2**: 821. 1891.
Spicanta attenuata O. Kuntze, Rev. Gen. Pl. **2**: 820. 1891.
Lomaria Féei Jenm. Bull. Bot. Dept. Jamaica **43**: 7. 1893.
Lomaria attenuata Willd. (as used by Jenman, loc. cit.).
Blechnum attenuatum Diels (in part), in E. & P. Nat. Pfl. **1**^{4}: 249. 1899.

Plants epiphytic. Rhizome wide-creeping, often 10–12 meters above the ground, 1–2 cm. thick, the scales linear, 7–14 mm. long, maroon to dark chocolate brown, usually with a black median line. Sterile fronds 25–95 cm. long; stipes scattered throughout 10–20 cm. from the apex of the rhizome, 6–28 cm. long, rarely angulate, without vestigial pinnae, bicolored with dark brown or blackish brown; lamina 20–80 cm. long, 4–15 cm. wide, shape either (1) narrowly lanceolate or else very narrowly oblong or linear with the greatest width the same for about half the length (15–30 cm.), gradually reduced at each end, the lower usually contiguous pinnae becoming triangular or more or less semicircular (type F base and approaching G) or (2) lanceolate in shape, gradually reduced at the apex, the lower sinuses becoming wider and the lower pinnae more abruptly reduced and sometimes distant (type F and approaching E, but rarely E), the pinnae mainly alternate; pinnae 25–75-jugate, falcate, the apex acute to acuminate, the base the widest part, but not very prominently dilated, 2.2–8 cm. long, 9–12 mm. wide; margins entire or sometimes subentire at the apex; leaf tissue rigid-herbaceous to coriaceous, without scales; veins usually indistinct above, usually appearing below as distinct, dark lines, or in the heavier plants often raised and cartilaginous, the apices somewhat glandular, the vein spaces 9–12 to 1 cm. Sporophyls 20–70 cm. long; stipes 8–24 cm. long, often with a few vestigial pinnae, usually bicolored; lamina 16–60 cm. long, abruptly reduced at the base, gradually reduced at the apex; pinnae 22–45-jugate, 3–8 cm. long, 2–3 mm. wide, with or without a contracted sterile tip 1–4 mm. long, not dilated at the base; indusium entire, not becoming lacerate; sporangia brown to dark brown.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Mexico, Central America, Panama, West Indies, and the Lesser Antilles.

SPECIMENS INCLUDED: MEXICO: State of Vera Cruz, County of Cordova, *Finck 87* (Y, N). COSTA RICA: Vicinity of Coliblanco, altitude about 1,950 m., climbing on trees, *Maxon 251* (Y, N).

Cañas Gardas, altitude 1,100 m., *Pittier 10987* (N). PANAMA: Cana and vicinity, altitude 6,000 ft., on tree, *Williams 923* (Y, N). CUBA: Without locality, *Wright 864* (Y, N). El Yunque Mt., Baracoa, climbing on tree fern, sink hole, *Underwood & Earle 980* (Y, N). JAMAICA: "Morce's Gap," altitude 5,000 ft., *Clute 81* (Y, N). Base of John Crow Peak, altitude 5,000–5,500 ft., climbing high on a tree, *Maxon 1249* (*Underwood 2377*) (N). Base of John Crow Peak, altitude 5,000–5,500 ft., *Underwood 558* (Y). HAITI: La Brande to Mt. Balance, creeping on tree, summit of Mt. Balance, *Nash & Taylor 1749* (Y). SANTO DOMINGO: Constanza, epiphytic in leafy woods, altitude 1,200 m., *von Türckheim 2996* (Y). PORTO RICO: Luquillo Mountains, *Wilson 142*.

Onoclea polypodioides Sw. is described as having clustered stipes, erect fronds, an inframarginal indusium, and as differing from *Osmunda Spicant* L. in magnitude, in the more acute and more curved pinnae, and in the remote not subconfluent fertile pinnae. These characteristics, taken with the clustered appearance of this scandent species, and with the smaller size of the European *Spicant*, fix the name without doubt upon the Jamaican fern described above. The dimorphous character of this species probably caused Swartz to change the specific name to *onocleoides*, before he finally transferred it to *Onoclea*, where he took again the original specific name *polypodioides*. He plainly states the synonym in each case, so that there is no reason for including both *onocleoides* and *polypodioides* as several fern writers have done.

Several species have been reduced to synonymy with *polypodioides*, either by Christensen or in this paper. Liebmann's own sheet of *L. fragilis* can not be distinguished from young leaves of *L. polypodioides*. The same is true of the picture and of the type sheet of Fée's *L. decrescens* (Cuba, *Linden 2019*); and Fée's description contains too many contradictions to be of any value. *L. mexicana* Fée is later described by Fée as synonymous with *L. fragilis* Liebm. The shorter fertile frond and the lack of any distinctive character even in one of Liebmann's own sheets prevent the separation of *fragilis* from *S. polypodioides*.

Neither can *L. Féei* of Jenman be clearly distinguished from *S. polypodioides* for (1) the same plants show both forms of bases of the laminae; and (2) the same collection number* has fronds with and also without the raised cartilaginous veins, which are but irregularly present in the plants possessing them. Several plants from Cuba, Haiti, and Jamaica, however, show such veins; they are usually coriaceous in texture, the pinnae are longer and usually *linear*-falcate in shape, and the bases of the laminae are rather more abruptly reduced (type E) with occasionally distant pinnae. These same characters are, however, found in some fronds without the raised cartilaginous veins; and like the veins, they are not uniform in all the fronds of the same plant.

The specimens from Costa Rica and Panama have very long and proportionately narrow sterile fronds, a form evidently commoner in Jamaica than in other islands. These mainland plants differ also from most of the island specimens in having very narrow, acuminate scales, with very long, slender teeth, which are variously curved and often sharply recurved and hooklike. Separation of these plants is impossible, however, because of intermediate forms. Several Mexican plants (*Finck 87*) have similar fronds; the scales are also very like those of the Costa Rican and Panama plants, except that the black median line is often wanting. Among the specimens from Jamaica are several sheets (*Underwood 558* and *Maxon 2725*) which have scale margins intermediate between those described above and the usual island type with short, straighter teeth.

Three sheets from Costa Rica ("Vallée du Dignis," epiphytic exclusively on trees, altitude 700 m., *Tonduz 12005*) are mentioned here chiefly because of their epiphytic habit. The black-centered scales are not long-toothed like the other Costa Rican plants. The entire, linear laminae with winged stipes suggest Kunze's *Lomaria pteropus*.† His plants had similar scales, but much shorter, broader laminae with fewer pinnae, 3–12-jugate probably, while these Tonduz specimens are 17–25-jugate. The stipes of *pteropus* are bordered by straight-edged extensions; in the Tonduz plants the wings are composed of several pairs of confluent, rounded lobes. Kunze describes his plant as barely covered with earth; Tonduz's specimens are positively epiphytic.

* This variation is shown in eight sheets of *Wright 864*, and in single collection numbers of more careful collectors in recent years: Nash, Maxon, and Underwood.

† Kunze, Farrnkr. 97. *pl. 46.* 1840; Raddi, Pl. Bras. 1: 5. *pl. 17.* 1825.

Unfortunately the fertile fronds are lacking; if these Tonduz plants do not belong with *pteropus*, they should nevertheless be separated from *polypodioides*. Without the fertile fronds it is, of course, impossible to place them with certainty.

Two incomplete specimens from Costa Rica ("Forêts du Roble, volcan Frazu," *Pittier & Durand 4132*, and U. S. National Herbarium no. 575238, without definite locality, *Wercklé*) and one from Nicaragua (Omotepec, *C. Wright*) suggest the Tonduz plants in the breadth and texture of the lamina and in the shape of the pinnae; they lack the winged stipes, however.

8. S. SPICANT (L.) Weis, Pl. Crypt. Fl. Gott. 286. 1770.

Osmunda Spicant L. Sp. Pl. 1066. 1753.

Acrostichum Spicant Willd. Prod. Fl. Berol. 289. 1787.

Blechnum Spicant J. E. Sm. Mém. Acad. Turin **5**: 411. 1793.

Onoclea Spicant Hoffm. Deutsch. Fl. **2**: 12. 1795.

Osmunda borealis Salisb. Prod. 402. 1796.

Acrostichum lineatum Cav. Anal. Hist. Nat. **1**: 106. 1799.

Asplenium Spicant Bernh. Jour. Bot. Schrad. **1799**^{2}: 309. 1800.

Blechnum boreale Sw. Jour. Bot. Schrad. **1800**^{2}: 75. 1801.

Lomaria Spicant Desv. Ges. Nat. Fr. Berl. Mag. **5**: 325. 1811.

Lomaria crenata Presl, Rel. Haenk. **1**: 51. 1825.

Blechnum doodioides Hook. Fl. Bor.-Am. **2**: 263. 1840.

Spicanta borealis Presl, Epim. Bot. 114. 1851.

Struthiopteris doodioides var. Trev. Atti Ist. Ven. III. **14**: 571. 1869.

Plants terrestial. Rhizome more or less inclined, apparently short, 7 mm. to 2 cm. thick, the scales lanceolate, 5–10 mm. long, chestnut to maroon or brown, darker and thicker toward their base. Sterile fronds 20–70 cm. long, of two types: (1) clustered, shorter, spreading, coriaceous or rigid-herbaceous ones with very short stipes and close pinnae, and (2) from the center of those just described, taller, more or less erect, herbaceous fronds with long stipes, much longer pinnae, and wider sinuses; stipes clustered at the apex of the rhizome, 3–27 cm. long, somewhat or not at all angulate, without vestigial pinnae, variously colored, reddish brown, yellowish brown, or purplish chestnut, but not bicolored; lamina 21–60 cm. long, 2–9 cm. wide, narrowly elliptical to linear, very gradually reduced at the base (type G), and gradually reduced at the apex, the pinnae often opposite near the middle or the base of the frond; pinnae 36–80-jugate, oblong-linear to linear-falcate, the apex rounded-acute, the base prominently dilated in the larger, more open laminae, 1–5 cm. long, 4–10 mm. wide, often opposite, especially near the base; margins entire, irregularly revolute in some of the smaller, heavier fronds only; leaf tissue membranous to coriaceous as previously described, a few of the thinner ones somewhat punctate as in *S. exaltata*, without scales, except rarely a few minute fibrillose ones on the rachis; veins* neither raised nor grooved, the apices but slightly or not at all glandular, vein spaces 10–15 to 1 cm. Sporophyls 38–120 cm. long; stipes 11–60 cm. long, often marked for a short distance by vestigial pinnae, darker than the sterile; lamina 19–60 cm. long, 4–10 cm. wide, very gradually reduced at the base and at the apex; pinnae 40–50-jugate, 2.2–5 cm. long, 2–3 mm. wide, the apex acute, with or without a contracted sterile tip 1–2 mm. long, the base decidedly dilated; indusium membranous, usually entire or subentire, sometimes irregularly broken, never becoming lacerate; sporangia dark brown.

DISTRIBUTION: Pacific coast from California to Alaska.

SPECIMENS† INCLUDED: CALIFORNIA: Humboldt County, damp shady woods, *Kellogg & Hartford 1175*. OREGON: Nehalum, creek banks and dry woods, *Kirkwood 110*. WASHINGTON: Near Tacoma, shady ravines and springs, *Flett 2030*. BRITISH COLUMBIA: Revelstoke, woods, altitude 1,600 ft., *Shaw 835*. Stevens Pass, altitude 1,150 m., *Sandberg & Leiberg 774*. ALASKA: Windham Bay, *Culbertson 4936*. Ketchikan, near stream leading from Ketchikan Falls, *Broadhurst 101*.

Two fronds collected by Douglas in the interior of northwestern America (exact locality not given) formed the type of Hooker's *Blechnum doodioides;* the half sterile, half fertile leaves, with their occasionally forked pinnae indicate an abnormal condition, and could not be considered as characterizing a valid species. Similar abnormal forms are not uncommon in other species of this genus. The veining of the fertile pinnae and the short, often unconnected sori suggest *Woodwardia* or *Doodia*. The costal sori are characteristic of *Blechnum*, but there are no Blechnums in this region. Abnormal fronds in other species often show great vari-

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* The veins are normally once forked; but the *crenata* variety is often twice forked; if the margin is deeply crenate, one main vein may have two or three veinlets on each side. Another variation in the veining is found in *Umbach 611* from Skykomish, Washington, where an apparently normal *S. Spicant* has anastomosing veins in the lower half of many of the pinnae; the veins form one row of areolae along the midrib, and do not branch again before reaching the margin.

† These specimens are all in the herbarium of the New York Botanical Garden.

ation in the width of the sterile part of the fertile pinnae. The plants described under *Blechnum doodioides* therefore without doubt represent abnormal forms of *S. Spicant*, which Hooker* admits is "the only Lomarioid plant in so northern a latitude"; the general shape, the cutting, and the dark stipes support this supposition. *L. crenata* Presl (type from Vancouver Island) is described as differing from *S. Spicant* in being larger, and in having acute, crenate pinnae, the lower ones deflexed and ear-shaped. These characters are found in five sheets from Washington and Oregon (Howell's collections of 1876, 1879, and 1880 and in Flett's no. 1928); Flett's collecting note says: "this form is rare and seems to be confined to the largest plants in the dense, mossy woods." The name *L. Spicant*, var. *serratus* Wall. appears on some of these sheets. No further record of this name has been found.

9. **S. stolonifera** (Mett.) Broadh. comb. nov.

Blechnum stoloniferum Mett. in herb. Meissn.; Fourn. Mex. Pl. **1**: 113. 1872.

Lomaria stolonifera Fourn. Mex. Pl. **1**: 113. 1872.

Lomaria Gheisbreghtii Baker; Hook. & Baker, Syn. Fil. ed. 2. 481. 1874.

Spicanta Ghiesbreghtii O. Kuntze, Rev. Pl. **2**: 821. 1891.

Blechnum stoloniferum C. Chr. Ind. Fil. 160. 1905.

Blechnum Ghiesbreghtii C. Chr. Ind. Fil. 154. 1905.

Plants terrestrial. Rhizome creeping and stoloniferous, 15 cm. long (in type), slender, 1–2 mm. thick, the scales lanceolate to ovate-lanceolate, 1–4 mm. long, yellowish brown to tobacco brown. Sterile fronds 11–20 cm. long;† stipes clustered, 5 mm. to 4 cm. long, usually slightly angulate, without vestigial pinnae, uniformly castaneous to dark violet or lighter colored in the channel, occasionally with a few ovate-lanceolate to ovate, dull brown deciduous scales; lamina 8–16 cm. long, 17–36 mm. wide, elliptical, gradually reduced at the base (type F) and slightly less so at the apex; pinnae 16–22-jugate, triangular-falcate to oblong-falcate, the apex rounded or obtuse, but often apparently acute because of the irregularly revolute margin, the base more or or less dilated, 6–18 mm. long, 4–5 mm. wide; margins entire, irregularly and but slightly revolute; leaf tissue herbaceous, roughish in drying, never smooth as in the

* Sp. Fil. **3**: 60. 1860.

† Usually less than 18 cm. long.

thinner fronds of *S. Spicant*, very finely punctate much as in *S. exaltata*, without scales; veins indistinct, without conspicuous glandular apices, vein spaces 10–12 to 1 cm. Sporophyls taller, 25–28 cm. long; stipes slender, 9–13 cm. long, reddish brown to almost black, usually shining; lamina 7–16 cm. long, abruptly reduced at the base with slight indications of vestigial pinnae or gradually reduced with the lower pinnae sterile, the apex gradually or abruptly reduced; pinnae 12–19-jugate, 1–2 cm. long, 2–3 mm. wide, falcate, with an abrupt sterile tip 1–2 mm. long, the base dilated; indusium delicate, entire; sporangia tobacco brown or darker.

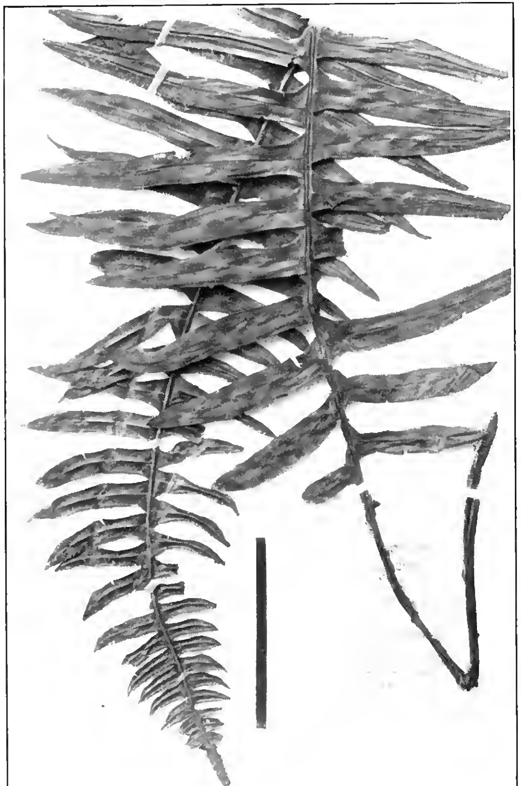
TYPE: *Müller 1491*, no. 61 in Meissner herbarium (Y) from Orizaba, Mexico.

DISTRIBUTION: Known from Mexico only.

SPECIMENS INCLUDED: MEXICO: State of Hidalgo, Trinidad, wet banks, *Pringle 8752* (N). State of Hidalgo, Barranca, below Trinidad Iron Works, 5,700 ft., *Pringle 13808* (N). Chiapas, *Ghiesbreght 207* (Kew; College of Pharmacy, Columbia University).

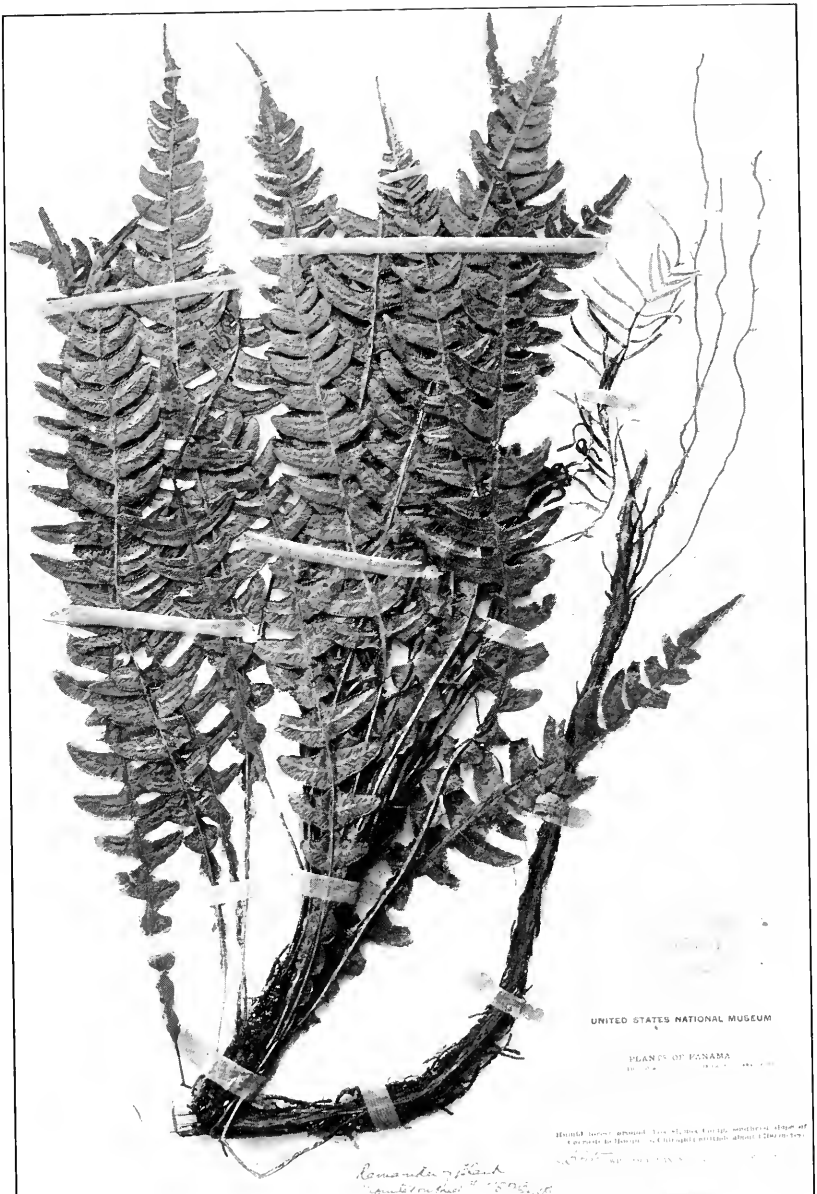
The type of *L. Gheisbreghtii* Bak., *Ghiesbreght 207*, cannot be distinguished from *S. stolonifera*, though Christensen in his Index Filicum considers it a valid species. One or more of the taller sterile fronds in the two type numbers seen have wider sinuses, giving the lamina a slightly more open appearance than the rest of the fronds of these or of the other specimens of *S. stolonifera*. The College of Pharmacy specimen of *Ghiesbreght 207* has also a short, undeveloped stoloniferous shoot.

S. stolonifera differs from *S. Spicant* in texture, never possessing the smooth almost transparent pinnae of the more delicate specimens nor the coriaceous texture of the smaller fronds of *S. Spicant*. The lamina is much smaller, and the pinnae often lie so close together that the lamina usually appears lobed rather than fully pinnate; the pinnae are never linear, and as indicated in the key, are proportionately much broader than in *S. Spicant*. Three pots of *S. stolonifera*, now in the New York Botanical Garden conservatories, have the shorter sterile fronds arranged in a flattened rosette at the base, one of the taller sterile fronds at an angle of about 30 degrees, and the fertile ones erect or almost so. In this they resemble *S. Spicant;* it would be interesting to know if *S. Spicant* is ever stoloniferous.



STRUTHIOPTERIS JAMAICENSIS Broadh. $\frac{1}{4}$.

(A scale 10 cm. long is shown on each sheet.)



STRUTHIOPTERIS MAXONII Broadh. × 3/8.

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 39: 357-385, *pls. 20-29.* 16 Au 1912.]

The genus Struthiopteris and its representatives in North America—II*

JEAN BROADHURST

(WITH PLATES 26-29)

The bases of the pinnae in the species previously described are fully adnate; in the following species the lower pinnae, at least, are distinctly petioled, except possibly in two species. Usually the upper pinnae are more or less adnate or even somewhat decurrent; when they are free throughout, the fact is definitely stated.

The petioled species, except in *S. Shaferi, rufa, Underwoodiana,* and *Werckleana,* have somewhat cartilaginous margins; the swollen or glandular vein apices usually give a subserrate to serrate character to this margin. When fully revolute, both the serrate and the cartilaginous character might pass unnoticed; extremes with regard to both of these characters are found in the non-revolute forms, *S. varians* and *S. falciformis.* In such plants as *S. falciformis* the veins could not, of course, be described as "not reaching the margin."

In the non-petioled species the scales are usually confined to the rhizome and the basal part of the stipe. In the following group the basal stipe scales are much more numerous, and similar but smaller ones are found on the rachis and often on the costae. Even the veins of the pinnae may have a delicate araneous covering of minute scales or fibrils. These araneous scales are definitely mentioned when present; the scales of the rachis and costae are not separately described unless they are very numerous or differ greatly from those of the stipe.

[The BULLETIN for July 1912 (39: 301-356. *pl. 24, 25*) was issued 23 Jl 1912.]

* For part I see Bull. Torrey Club 39: 257-278. *pl. 21, 22.* 10 Jl 1912.

Most of the petioled species are very large, and complete sterile and fertile leaves are not always found in the same herbarium number; therefore, in this paper the comparative height is often omitted, though it may be more or less accurately deduced from the figures given for the length of the sterile and the fertile fronds, respectively.

Key to the petioled species

B. Sterile pinnae (at least the lower ones) petioled;* rhizome scales rigid or flaccid; pinnae more or less scaly; indusium irregularly lacerate to fimbriate with age

Rhizome scales very slender, rigidly erect, with dark centers; vestigial pinnae† present; margins entire; coriaceous (rigid-herbaceous in *S. Underwoodiana*).

Sterile lamina very abruptly reduced at the base (type A, with vestigial pinnae); pinnae crowded to overlapping, elliptical, obtuse; dried pinnae rolled and rufous below; margins revolute. — 16. S. *rufa*.

Sterile lamina abruptly reduced at the base (type D, with vestigial pinnae except in *S. Shaferi*); pinnae never crowded or overlapping, narrowly oblong to linear, acute to acuminate; dried pinnae not rolled, gray-green to yellowish brown or brown below; margins‡ not revolute.

Apex of the sterile lamina gradually reduced; upper sterile pinnae not conspicuously dilated both ways at the base, the base of the lower ones cuneate, petioled; deciduously araneous below; vein spaces 18–20 to 1 cm.; rachis scales mixed with white, fibrillose ones. — 25. *S. Werckleana*.

Apex of the sterile lamina not reduced; upper sterile pinnae conspicuously dilated both ways at their base, the bases of the lower ones barely petioled, rounded; not araneous below; vein spaces 10–16 to 1 cm.; rachis without white, fibrillose scales.

Lower sterile pinnae prominently dilated or auricled at the base; stipes short, 3–10 cm. long, without vestigial pinnae; costae not flattened on the under side; vein spaces 15 or 16 to 1 cm.; indusium light-colored, regularly lacerate to its base, concavely hollowed on the sides of the lacerations. — 19. *S. Shaferi*.

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* *S. Underwoodiana* and *S. Shaferi*, the only forms not distinctly petioled, have rigid rhizome scales which are never found in the species in the preceding division.

† Except in *S. Shaferi*.

‡ Incompletely and very narrowly so in *S. Shaferi*, which is peculiarly glandular; see description.

Lower sterile pinnae not dilated or auricled at the base; stipes 18–36 cm. long, with vestigial pinnae; costae flattened on the under side; vein spaces 10–13 to 1 cm.; indusium dark, only occasionally lacerate to the base, not concavely hollowed on the sides of the lacerations. 21. *S. Underwoodiana.*

Rhizome scales broad, flaccid, without dark centers; vestigial pinnae * lacking; margins more or less serrate; membranous to rigid-herbaceous.†

Sterile pinnae with rounded to tapering bases.

Pinnae 2–5-jugate, 4–7.5 cm. long, ovate to ovate-lanceolate, with an acute apex. 13. *S. danaeacea.*

Pinnae 8–25-jugate, 9–26 cm. long, lanceolate to linear, with an acuminate apex.

Margins conspicuously and irregularly erose; stipes red-purple; lamina not reduced at the apex. 22. *S. varians.*

Margins entire to finely serrate; stipes shining straw-colored to dull, pale brown; lamina reduced at the apex in all except the smallest forms. 17. *S. Schiedeana.*

Sterile pinnae with cordate, or rarely subcordate, bases.

Stipes with vestigial pinnae, closely covered with peculiar, appressed, amorphous scales, ordinary scales lacking; viviparous near the apex of the rachis; lamina not reduced at the apex. 24. *S. vivipara.*

Stipes without vestigial pinnae, ordinary scales present, with or without fibrillose or somewhat formless appressed ones; not viviparous; lamina reduced at the apex (except in the smaller *S. striata* specimens).

With red-purple to black stipes; pinnae with an acute (or obtuse?) apex; lower fertile pinnae usually with spurlike protuberances. 23. *S. violacea.*

With straw-colored to chestnut stipes; pinnae with an acuminate apex; lower fertile pinnae usually without spurlike protuberances.

Margins never revolute, but sharply, finely, and regularly cartilaginously serrate throughout. 14. *S. falciformis.*

Margins irregularly or fully revolute, definitely serrate at the apex only.

Stipe scales narrow, short, 2–6 mm. long, projecting; appressed finer ones inconspicuous. 10. *S. chiriquana.*

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* Except in *S. vivipara.*

† Except in the smaller specimens of *S. violacea* and one St. Vincent specimen of *S. striata.*

Stipe scales broad, 1–2 cm. long, flaccid and lying more or less crumpled along the stipe; appressed somewhat formless ones present and numerous in most species.
- Sterile pinnae mainly straight; lamina usually 1.5 (rarely 2) times as long as wide; pinnae 6–24-jugate; lower surface with definitely raised veins; margins revolute.
  - Pinnae 20–24-jugate, the apex acuminate, the base subcordate; lower surface not araneous. — 12. *S. costaricensis.*
  - Pinnae 6–23-jugate (averaging 10–18-jugate), the apex abruptly acuminate, the base fully cordate; lower surface usually finely araneous. — 20. *S. striata.*
- Sterile pinnae mainly falcate; lamina 2–4 times as long as broad; pinnae 21–70-jugate; veins not raised below (except irregularly so in *S. Christii*); margins rarely fully revolute.*
  - Sterile stipes chestnut; veins more or less raised below; fertile pinnae occasionally with spurlike protuberances. — 11. *S. Christii.*
  - Sterile stipes straw-colored to brownish; veins not raised below; fertile pinnae without spurlike protuberances.
    - Sterile pinnae 20–40-jugate; fertile pinnae without a glandular, basal enlargement of the petiole. — 15. *S. lineata.*
    - Sterile pinnae 60–70-jugate; fertile pinnae with a glandular, basal enlargement of the petiole. — 18. *S. sessilifolia.*

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* Except possibly in *S. sessilifolia;* the condition of the type specimen seen makes it difficult to determine this.

10. **S. chiriquana** Broadh. sp. nov.

Plants terrestrial. Rhizome (not seen) evidently large, the scales lanceolate, 4–10 mm. long, snuff brown to tobacco brown. Sterile fronds 1.7–2.1 m. long; stipes 71–86 cm. long, 1–1.6 cm. thick at the base, angulate, reddish brown to purplish brown, the scales lanceolate, 2–6 mm. long, yellowish to purplish brown, projecting noticeably from the stipe and mixed with smaller, finer ones which are more or less appressed; lamina 106–123 cm. long, 38–45 cm. wide, oblong, slightly reduced at the base (between type B and C * in the normal frond seen, without vestigial pinnae), the apex gradually reduced, the terminal pinna 6.5–9 cm. long, the lower pinnae more or less opposite; pinnae 44–50-jugate, narrowly lanceolate, straight to slightly curved, the apex serrate, long-acuminate, the base subcordate to cordate, the upper pinnae adnate, the lower pinnae sometimes long-petioled (1 cm.), 19–25 cm. long, 2.3–3 cm. wide; margins narrowly revolute;† leaf tissue rigid-herbaceous, the under surface but slightly or not at all araneous, the costae almost naked; veins more or less raised below (not so distinctly as in most specimens of *S. striata*), the vein spaces 12–15 to 1 cm. Sporophyls 1.6 (in young plant)–2.4 m. long; stipes 64–112 cm. long, slightly lighter than the sterile, or yellowish and tinged with reddish brown; lamina 98–124 cm. long, rather gradually reduced at the apex, the base slightly or abruptly reduced; pinnae 49–52-jugate, 15 to 23 cm. long, 3–5 mm. wide, the apex with a sterile tip 3–5 mm. long, the base rounded; sporangia yellowish brown; indusium delicate, very early deciduous, and irregularly lacerate. [PLATE 26.]

Type in the U. S. National Herbarium, no. 676110 to 676114 inclusive, collected in humid forests of the upper Caldera watershed between "Camp I" and the Divide, Holcomb's trail, above El Boquete, Chiriqui; altitude 1650–1925 m., *William R. Maxon 5650*, March 23, 1911.

SPECIMENS INCLUDED: U. S. National Herbarium, no. 675825 to 675828 inclusive, collected in humid forests of Cuesta de Las Palmas, southern slope of Cerro de la Horqueta, Chiriqui, altitude 1700–2100 m., *Maxon 5442* (partly abnormal), March 18, 1911.

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* Bull. Torrey Club **39**: 264. *f. 1.* 10 Jl 1912.

† Irregularly revolute in the abnormal plant, *Maxon 5442*, included in this species. The revolute part is narrow when compared with that in *S. striata*, which has pinnae about equal in width.

Maxon's two plants vary in the bases of the sterile pinnae; in no. 5650 the base is gradually narrowed through a distance of about 2 cm.; in the other, no. 5442, the base is the widest part of the pinna. Excepting also the irregular character of the margin of the latter, the two plants are similar; there is nothing else from the mainland that approaches them in stipe characters, and only one plant (*Tonduz 10907*, the type of *S. sessilifolia*) with such long, numerous pinnae. *S. chiriquana* differs from *S. sessilifolia*, however, in having brightly colored, shining stipes, the upper pinnae partly adnate, straighter pinnae with practically naked costae, and much lighter colored fertile pinnae with very delicate, deciduous indusia.

11. **S. Christii** (C. Chr.) Broadh. comb. nov.

Lomaria spissa Christ, Bull. Boiss. II. 4: 1092. 1904. (Not *L. spissa* Fée.)

Blechnum Christii C. Chr. Ind. Fil. 152. 1905.

Lamina very large; "rachis" 1 cm. thick, red-brown; pinnae 20 cm. long, 2 cm. wide, the apex elongated, the base cordate and sessile, covering and extending beyond the rachis; margins finely dentate with regularly crisped undulations; costae scaly, the scales oval, appressed; veins prominently projecting below. (Sporophyls not described.)

TYPE: In Christ's herbarium; from Costa Rica.

DISTRIBUTION: Apparently limited to Costa Rica.

SPECIMENS INCLUDED: COSTA RICA: Tablaro, "1900 m. VII, '08," *Braveas 143* (N).

Christensen changed the specific name of Christ's *Lomaria spissa* to *Christii*, because Fée had earlier used *L. spissa* for an African species. The very incomplete description given above has been rearranged from Christ's description of *L. spissa*. Following are some additions based upon the sheet from Christ's herbarium mentioned above. The fertile frond is slightly abnormal, having broad sterile tips on some of the pinnae; the following additions have not been incorporated into the description. though a fragment kindly sent by Christ indicates that these smaller fronds are, except in size, decidedly like his specimen.

Sterile frond 52 cm. long; stipe 14 cm. long, and 1 cm. thick at the base, angulate, the scales numerous, deciduous, 1–2.5 cm.

long, yellowish brown, flaccid, loosely appressed, accompanied by small linear or araneous ones; lamina 39 cm. long, 19 cm. wide, ovate-lanceolate, not reduced at the base (type A, without vestigial pinnae), gradually reduced at the apex, the scales smaller on the costae, the under surface finely araneous; pinnae 21-jugate, narrowly lanceolate to linear-falcate, the apex acuminate, serrate, the base cordate, the lowest pinnae petioled; margins slightly and irregularly revolute and therefore appearing subentire; leaf tissue rigid-herbaceous; veins irregularly raised below, the vein spaces 10–12 to 1 cm. Sporophyl (not mature) 64 cm. long, including the stipe; stipe 26 cm. long, lighter in color, partly yellow-brown, otherwise as in the sterile; lamina 38 cm. long, abruptly or not at all reduced at the base, rather abruptly reduced at the apex; pinnae 21-jugate, 9–11 cm. long, 2–3 mm. wide, the base cordate (at least in the lower pinnae), occasionally with spurlike protuberances;* sporangia very dark brown; indusium delicate, narrow, deciduous, subentire, irregularly and not fully lacerate.

12. **S. costaricensis** (Christ) Broadh. comb. nov.

Lomaria costaricensis Christ, Bull. Boiss. II. 4: 1092. 1904.

Blechnum costaricensis C. Chr. Ind. Fil. 152. 1905.

Plants terrestrial. Sterile fronds 60–80 cm. long; stipes at least 30 cm. long, irregularly angulate, straw-colored, the scales lanceolate, 1.5 cm. long, 4 mm. broad, soft, deciduous, mixed with fibrillose ones; lamina at least 41 cm. long, 28 cm. wide, broadly oblong, the rachis somewhat rugose, otherwise like the stipe;† the costae soon becoming naked, leaf tissue rigid-herbaceous, brittle and yellowish green when dry; pinnae 20–22-jugate, straight or slightly curved near their apex, acuminate, the lower ones slightly petioled, and subcordate at the base, 11–22 cm. long, 1.6–2 cm. wide, margins finely serrate or subserrate and somewhat revolute;‡ veins indistinctly raised, the vein spaces 16–20 to 1 cm. Sporophyl § indusium smooth, 2 mm. wide, edge entire but wavy, brown-ochre.

TYPE: In Christ's herbarium.

DISTRIBUTION: Costa Rica and Guatemala.

SPECIMENS INCLUDED: GUATEMALA: Alta Verapaz, Coban, 1350 m., *von Türckheim 1384*, 1907 (Y). Alta Verapaz, "In paludosis prope Coban," altitude 4,300 ft., *von Türckheim 353*, 1879 (N).

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* See footnote under *S. violacea*, p. 380.

† But with some whitish, appressed scales in the Guatemalan specimens.

‡ Von Türckheim's specimens from Guatemala are irregularly revolute; so is a pinna sent by Christ. Neither specimen is serrate as in *S. falciformis;* nor so definitely serrate as in any of the species so described in this paper.

§ According to Christ.

The above incomplete description has been rearranged from Christ's with some few additions based on von Türckheim's specimens. The fertile frond forming part of von Türckheim's no. 353 is somewhat mutilated; the two specimens afford the following additions:

Fertile frond 130 cm. long; stipe 60–68 cm. long, light, blotched with brownish, the scales few, yellowish brown; lamina 65–80 cm. long, the pinnae distant; pinnae 16–24-jugate, 13–16 cm. long, 4–5 mm. wide, heavy, with a sterile apex 1–5 mm. long, the bases decidedly cordate; sporangia yellowish brown or dark brown; indusium wavy and entire or irregularly broken, less lacerate than in most of the petioled species.

Christ kindly sent one sterile pinna of *S. costaricensis*. It was evidently one of the upper ones, measuring 10 cm. by 13 mm.; the color is not yellow as in *S. Werckleana*, but a light gray-green characteristic of recent specimens of *S. polypodioides* and common to several of the heavier species of *Struthiopteris;* the vein spaces vary from 16 to 18 to 1 cm.

13. **S. danaeacea** (Kunze) Broadh. comb. nov.

Lomaria danaeacea Kunze, Linnaea **18**: 326. 1844.

Blechnum danaeaceum C. Chr. Ind. Fil. 153. 1905.

Rhizome oblique, very paleaceous with reddish scales. Sterile fronds 10–40 cm. long; stipes clustered, 4–15 cm. long, with appressed scales which are larger toward the rhizome; lamina 8–10 cm. wide, short ovate-oblong, not gradually reduced above, the terminal pinna largest, 6–9 cm. long, often with a basal lobe, shining, lighter below; pinnae 2–5-jugate, ovate-lanceolate to ovate-oblong, the apex serrate, the base rounded, unequally subcuneate, free throughout, sessile, the lower pinnae short-petioled, 4–7.5 cm. long, 1.5–2.5 cm. wide; margins revolute; leaf tissue coriaceous;* costae raised below and chaffy with appressed scales; veins close and distinct. Sporophyls with light-colored, sparsely chaffy stipes; pinnae curved, numerous, long (12–15 cm. in parts of the fertile laminae seen in Kew and Geneva), the apex short-acuminate.

TYPE: Herb. Roemer, no. 121 and 122, from Mexico.

DISTRIBUTION: Known from Mexico only.

SPECIMENS INCLUDED: *Siebold 125* (Delessert Herbarium, Geneva; tracing, N).

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* Coriaceous as used here by Kunze and by many of the earlier writers evidently corresponds to rigid-herbaceous as now used.

The incomplete description given above is a translation of the original by Kunze, changed only as to measurements to include some smaller but mature fronds in the Delessert Herbarium at Geneva. Siebold's specimen seen there bears Kunze's name and is evidently a cotype of *L. danaeacea*. Christensen makes *L. deflexa* Liebm. a synonym of *danaeacea;* this it certainly is not, as *deflexa* is described as having *numerous* sterile pinnae. The validity of *Lomaria deflexa* itself might well be questioned, as no type specimen is indicated, and it is founded on a single sterile leaf (a not uncommon practice with Liebmann).

14. **S. falciformis** (Liebm.) Broadh. comb. nov.

Lomaria falciformis Liebm. Vid. Selsk. Skr. V. **1**: 234. 1849.
Blechnum falciforme C. Chr. Ind. Fil. 154. 1905.

Plants terrestrial. Rhizome (not seen), the scales lanceolate to ovate-lanceolate, 1–3 cm. long. Sterile fronds 70–150 cm. long; stipes 30–80 cm. long, often angulate, straw-colored to yellowish or reddish brown, varying greatly in the number and in the color of the deciduous scales, which range from straw, tan, and fawn to red-ochre; lamina 35–76 cm. long, 18–32 cm. wide, oblong, abruptly reduced at the base (type A, without vestigial pinnae), gradually reduced at the apex, the scales of the rachis like those of the stipe or darker; pinnae 18–32-jugate, linear or lanceolate, falcate to straight, the lower ones more curved than the upper, the apex acuminate, abruptly so in the widest forms, the base unequally and usually decidedly cordate, the lower pinnae distinctly petioled, 12–23 cm. long, 1.4–2.5 cm. wide; margins never revolute, finely, sharply, and regularly cartilaginously toothed, the teeth usually slanting forward, sometimes incurved; leaf tissue membranous to herbaceous; veins distinct, at least below, not heavy (often appearing as delicate dark lines), the vein spaces 12–15 to 1 cm. (9–12 in one very young frond and also in a single pinna, both determined by Liebmann). Sporophyls (incomplete) at least 65–80 cm. long; lamina 36–40 cm. long; pinnae 11–22 cm. long, 4–5 mm. wide, with a sterile apex 3–12 mm. long, the base cordate, usually petioled; sporangia dark brown; indusium lacerate.

TYPE: Cotypes (?) U. S. National Herbarium no. 474921 (an immature frond determined by Liebmann), "ad rivulos, Chiuautla,"* Mexico, May, 1841. Berlin herbarium (single pinna now in the New York Botanical Garden herbarium) *Liebmann 135*,

* Elsewhere spelled Chiuautata and Chiautla.

Chiuautla, Mexico. In his description, Liebmann attributes this species also to Puebla and Oaxaca, Mexico.

DISTRIBUTION: Mexico and Guatemala.

SPECIMENS INCLUDED: MEXICO: Oaxaca, "Santa Ines del Monte, Zimatlan-Oaxaca Mts.," altitude 3,000 m., *Conzatti 1313* (N). Oaxaca, "Cerro de San Felipe," *Conzatti and Gonzalez 529*, altitude 3,000 m. (N). GUATEMALA: Dept. Chimaltenango, Volcano Acatenango, altitude 8,500 ft., *Kellerman 6481* (N).

Liebmann described *L. falciformis* without seeing the fertile leaf; he probably had a young specimen, for a single pinna of the cotype from Berlin measures 14 cm., and he gives the length of the pinnae as 10 cm. (4 in.). Liebmann speaks of the pinnae as sessile, meaning, apparently, compared with his *L. spectabilis*, for a single sterile frond (U. S. National Museum no. 474921) determined by Liebmann has distinctly petioled lower pinnae. The specimen is apparently very immature. It differs, however, from Liebmann's description in having rounded rather than "obliquely cuneate cordate" bases, elsewhere described by him as unequally angled cordate; the margin of this specimen is *not* fully serrate and is but *slightly* cartilaginous. Notwithstanding these inconsistencies, the very peculiar margin (which does fit the fragment of Liebmann's Berlin specimen) makes it possible to place in this species the plants mentioned above. The Kellerman plant has straighter and proportionately narrower pinnae than the Berlin fragment; it differs still more in this respect from the other specimens included above. More material might make possible its separation.

A plant recently collected in Panama, in "moist ravines above El Potrero camp, Chiriqui Volcano, altitude 2890–3025 m.," *Maxon 5335*, may belong here. The texture is much heavier and the pinnae are shorter and broader than in the other specimens placed in this species; the margin is not quite like that of *S. falciformis*.

15. **S. lineata** (Sw.) Broadh. comb. nov.

Osmunda lineata Sw. Prod. 127. 1788.

Onoclea lineata Sw. Jour. Bot. Schrad. **1800**[2]: 73. 1801; Syn. Fil. 111. 1806.

Lomaria lineata Willd. Sp. Pl. **5**: 290. 1810.

Lomaria procera Spreng. (as used by Jenman and others).

Blechnum capense Diels (in part ?) in E. & P. Nat. Pfl. 1[4]: 249. 1899.

Blechnum lineatum C. Chr. Ind. Fil. 156. 1905.

Plants terrestrial. Rhizome erect, 10 cm. high (see discussion following this description), 3–5 cm. thick, the scales 1–2 cm. long, 2–6 mm. wide, burnt umber to tobacco brown. Sterile fronds 40–155 cm. long; stipes clustered, 18–90 cm. long, angulate, shining or dull, light-colored, or less often bicolored (with brown) or more rarely blotched with brown (purplish brown in some Cuban specimens), the scales numerous, brownish yellow, mixed with more or less fibrillose ones, very loosely appressed, at least toward the rhizome, more numerous than in *S. striata*, the attachment of the larger ones indicated by dark points or raised dots; lamina 28–74 cm. long, 8.5–36 cm. wide, oblong to narrowly lanceolate, slightly or not reduced at the base (type A, without vestigial pinnae), gradually reduced at the apex, the pinnae close to overlapping in the smaller plants; pinnae 18–40-jugate (usually 20–40), linear-oblong, falcate, the apex acuminate, serrate, the base cordate, often partly covering the rachis, often free throughout, the lowest pinnae petioled, 6.5–20 cm. long,* 0.9–2 cm. wide; margins subentire, somewhat cartilaginous, rarely revolute;† leaf tissue herbaceous to rigid-herbaceous, usually somewhat shining below, the costal scales smaller, usually numerous, tan, fawn, and buff, rarely araneous; veins rarely raised below, the vein spaces 13–18 to 1 cm. Sporophyls 92–146 cm. long; stipes 43–85 cm. long (one specimen has a chestnut cast, otherwise like the sterile); lamina 28–66 cm. long, slightly or not reduced at the base, somewhat reduced at the apex; pinnae 24–40-jugate, 8–18 cm. long, 3–4 mm. wide, with a sterile tip 5–10 mm. long, petioled, the lower bases rounded or cordate; sporangia very dark brown; indusium irregularly lacerate.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Cuba (?), Jamaica, Santo Domingo, and Porto Rico.

SPECIMENS INCLUDED: JAMAICA: Road from Cinchona to Morce's Gap, altitude 5,000 ft., *Underwood 258* (Y). Blue Moun-

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* But 5 cm. long in some immature (?) specimens from Cuba; see later discussion for other differences; a fragment from Jamaica consists of but two pinnae which are 42 cm. long. One abnormal specimen from Jamaica, *Underwood 2098*, has pinnae 2.4 cm. wide.

† Two growing plants of *S. lineata* now in the New York Botanical Garden conservatories have pinnae with non-revolute margins, which are narrowly cartilaginous and inconspicuously but sharply and finely serrate.

tain Peak, altitude 6,500–7,325 ft., *Underwood 1446* (Y). Lower slopes of Mt. Moses, moist shaded banks among bushes, altitude 2,000–2,500 ft., *Maxon 1049* (N). Cinchona, altitude 5,000 ft., *Clute 71* (Y, N).

Among these Jamaican plants, as in *S. violacea* and *S. striata*, there occur small but mature specimens differing mainly in size from the larger ones. These smaller plants have narrower laminae (3–4 times as long as broad instead of 2–2.5 times), the pinnae are closer and smaller (4.5–8 cm. long and 6–12 mm. wide as contrasted with pinnae 13–20 cm. long and 15–18 mm. wide); the leaf tissue is much heavier in these smaller forms. As indicated above, a similar range occurs in several other species, and it was not thought best to subdivide them. In this case, however, the rhizome may offer a real distinction. The smaller Underwood plant of *S. lineata* in the New York Botanical Garden conservatories already referred to in a footnote has an *erect* rhizome 10 cm. high and 4–5 cm. thick. The larger *S. lineata* plant incompletely labeled as from Jamaica, though larger in every other way, has a low spreading crown about 7 cm. broad and but slightly raised above the soil.*

Professor L. M. Underwood, who collected a great deal of *S. lineata* in Jamaica, stated that it is "very variable according to soil and light, and especially, age."

The two species, *S. lineata* and *S. striata*, have long been confused. The measurements given by Swartz indicate that in both cases he described small forms. He distinguished between them by describing *striata* (1) as having broader, almost entire, and sessile sterile pinnae, in which the whole apex is serrate; and (2) as having fertile pinnae with dilated cordate bases. A careful study of over thirty sheets from the type localities has shown (1) that many of the *S. lineata* group have fertile pinnae with cordate bases; (2) that the lower pinnae of *striata* are petioled; and (3) that the tips are serrate in most of the *lineata* group, also. Never-

* Other differences, which correspond to those found in herbarium specimens, are as follows: the smaller plant has stipes 15–17 cm. long, laminae 25–35 cm. long and 13–14 cm. wide, close to overlapping pinnae, which are 16–20-jugate, with the terminal pinna 6–7 cm. long; the larger plant has stipes 45–60 cm. long, more or less blotched with brown, laminae 45–60 cm. long and 20 cm. wide, pinnae not close, 25–27-jugate, with a terminal pinna 9–11 cm. long.

theless it is easy to select single plants from these localities which will justify the distinctions made by Swartz. Abundant material from these localities separates readily according to distribution, showing the following differences, mainly relative but sufficient to separate them. *S. lineata* has narrower sterile laminae and narrower, more numerous pinnae, which are more curved, not abruptly but gradually acuminate, shining below, and less revolute. The scales in *S. lineata* are more numerous and more persistent; they are mixed with finer and shapeless ones, which are more or less appressed to the stem; the costae contrast markedly with the commonly naked ones of *S. striata*, as do the smoother, often shining, under surfaces of the pinnae with the finely araneous condition of the strongly raised veins on the under surface of *S. striata*. A plant from Santo Domingo (*Eggers 2041*, "monte Barrero," altitude 1,100 m.) has very heavy, more numerous (58-jugate), narrow, close pinnae with deeply cordate bases; the rachis is densely chaffy and also fibrillose, and the scales on the costae are numerous, more uniform, and heavier in texture. More material might make possible its separation from *S. lineata*.

Some recent material from Cuba, collected by J. A. Shafer at Oriente (no. 4150 and no. 9038), shows plants with very narrow fronds, and narrow pinnae which (when fully mature) are heavier than any of the *S. lineata* specimens seen, except the plants mentioned above collected by Eggers. Shafer's no. 8059, also from Oriente, is like *S. lineata* in the narrow lamina but has short and proportionately broad pinnae (suggesting *S. striata*, in proportion only); as in *S. lineata*, the margins are subentire to almost serrate, not revolute, and the veins are not raised below; the scales throughout are more like those of *striata;* the stipes are dark reddish brown and the rachises similar. More material from Cuba is most desirable; excepting *S. Shaferi* these are the only Cuban representatives of the petioled species.

16. **S. rufa** (Spreng.) Broadh. comb. nov.

Lomaria rufa Spreng. Nova Acta **10**: 230. 1821; Syst. **4**: 63. 1827.

Lomaria robusta Fée, Gen. Fil. 69. 1852.

Plants terrestrial. Rhizome subarboreous (in *Duss 4164*, 20 cm. long and 12 cm. thick), the scales 2.5–3.5 cm. long, linear, 1–2 mm. wide, rigidly erect, dark tobacco brown or burnt umber with definite lighter margins. Sterile fronds 30–58 cm. long; stipes 9–20 cm. long, more or less irregularly angulate, marked throughout by vestigial pinnae, dull brownish, not shining, the scales like those of the rhizome, but shorter, less numerous, and abruptly wider at the base, mixed with finer, soft, light brown to rufous ones, the position of the fallen scales plainly indicated as in *S. lineata;* lamina 28–40 cm. long, 13–20 cm. wide, elliptical to oblong, abruptly reduced at the base (type A, with vestigial pinnae) gradually reduced at the apex, terminal pinna 4–7 cm. long, the pinnae crowded to overlapping, the lower often deflexed (at least in dried specimens), the rachis scales mixed with more numerous, fine or fibrillose, matted scales; leaf tissue very heavy and coriaceous, becoming rolled and rufous below in drying, the costae more or less fibrillose, the under surface usually araneous with similar yellowish to rufous scales (the upper surface of the costae occasionally slightly fibrillose also); pinnae 12–25-jugate, elliptical to oblong, the apex obtuse, appearing acute in some "rolled" specimens, the base rounded, short-petioled in the lower pinnae, 6–10 cm. long, 17–27 mm. wide; margins revolute; veins not raised below, sometimes rather distinctly grooved above, the vein spaces 13–18 to 1 cm. Sporophyls taller, 67–114 cm. long; stipes 15–57 cm. long; lamina 33–60 cm. long, abruptly reduced at the base, slightly reduced at the apex; pinnae 20–35-jugate, thick or heavy, 15–16 cm. long, 5–6 mm. wide, the petioles heavy; sporangia dark brown; indusium quite regularly lacerate. [PLATE 28.]

TYPE LOCALITY: "Islands of the Caribbean."

DISTRIBUTION: Guadeloupe only, apparently.

SPECIMENS INCLUDED: GUADELOUPE: "Plateau de la Soufrière (autour du lac de soufre), 1895," altitude 1,420 m., *Duss 4164* (Y, N); U. S. National Museum no. 524499, *Duss*. *L'Herminier 27* (Geneva; tracing, Y).

Fée himself says that his *Lomaria robusta* is near *L. rufa* Spreng.; and the rufous, oblong, obtuse, coriaceous pinnae of Sprengel's description, described from the islands of the Caribbean, are so characteristic that there seems to be no reason for disregarding the older name of *rufa*.

17. **S. Schiedeana** (Presl) Broadh. comb. nov.

Lomaria Schiedeana Presl, Linnaea **5**: 613. 1830; Tent. 143. 1836.

Lomaria longifolia Schlecht. Mém. Acad. Brux. **15**: 49. 1842.

Lomaria spectabilis Liebm. Vid. Selsk. Skr. V. **1**: 235. 1849.

Lomaria acrodonta Fée (?), Mém. Foug. **8**: 70. 1857.

Blechnum ornifolium C. Chr. (in part). Ind. Fil. 157. 1905.

Plants terrestrial. Rhizome (not seen), the scales (in Guatemalan species at least) large, 2.5–3 cm. long, 5–10 mm. wide, more or less plicate, burnt umber. Sterile fronds 1.1–2 m. long; stipes 70–80 cm. long, irregularly angulate, light-colored (and shining in the Guatemalan species), the scales yellowish brown to snuff-colored, very deciduous; lamina 45–86 cm. long, 20–50 cm. wide, oblong, but slightly or not at all reduced at the base (type A, without vestigial pinnae), gradually reduced at the apex (except in the smallest forms which are not reduced),* the rachis with few scales and usually fibrillose in the channel; pinnae 18–25-jugate (8–15 in the smaller forms), lance-oblong, straight or somewhat curved (falcate in the smaller forms), the apex serrate. acuminate to long-acuminate, often abruptly so, the base rounded or even tapering (the pinnae all free in the smaller fronds), the lower pinnae long-petioled, 24–36 cm. long (9–15 in the smaller forms), 1.8–3 cm. wide; margins entire to finely serrate, more or less cartilaginous; leaf tissue membranous to herbaceous or barely rigid-herbaceous, the surface sometimes shining, the costae finely fibrillose or naked; veins† not raised, but distinct below, the vein spaces‡ 13–18 to 1 cm. Sporophyls 50–160 cm. long; lamina 38–100 cm. long, slightly or not at all reduced at the base, gradually reduced at the apex; pinnae 15–26-jugate, 8–20 cm. long, 3–5 mm. wide, with a sterile tip 2–5 mm. long, more or less petioled; sporangia dark brown; indusium delicate, narrow, and sparingly lacerate.

TYPES: 1. (*Lomaria Schiedeana*) Mexico, *Schiede 781* (Berlin; fragments and tracing, Y). 2. (*Lomaria longifolia*) Mexico, Cordilleras, Vera Cruz, altitude 4,000 ft., *H. Galeotti 6406*, 1840 (Kew and also Delessert Herbarium, Geneva; tracings, Y).

DISTRIBUTION: Apparently confined to Mexico and Guatemala.

SPECIMENS INCLUDED: MEXICO: Herb. Rovirosa, no. 846, Chiapas, "Habitat inter pago San Bartolo et Las Nubes," alti-

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* The type of *L. Schiedeana* is a small plant and is not reduced at the apex.

† The vein apices are so swollen in one Guatemalan plant that the true cartilaginous margin seems almost intramarginal.

‡ Vein spaces 14–16 in the type of *S. Schiedeana* and in all the larger specimens, except possibly the Galeotti specimens.

tude 1,400 m. (Y). Totutla, *Liebmann*, U. S. National Museum no. 591311. GUATEMALA: Guatemala (Dept.), altitude 4,500 ft., *J. D. Smith 2427* (N). Alta Verapaz, "Sumpfiger Boden bei Coban," altitude 4,300 ft., *von Türckheim 353** (N).

Liebmann published *L. spectabilis* to include the earlier *L. longifolia* Schlecht. and *L. Schiedeana* Presl. He considered *L. longifolia* † invalid because that specific name had been previously used for a twining species. The description consists merely of the name, the type number (*Galeotti 6406*), the height (5–6 ft.), and the habitat (borders of "ruisseaux"). *L. Schiedeana* was little more than a name, as Liebmann states. It, also, however, was accompanied by a type number, *Schiede 781* (herb. no. 19849), and the statement that it differed from *L. striata* in having an elliptical-obtuse instead of a subcordate base.

Galeotti's specimens, seen in Kew and Geneva, seem at first quite different from the fragments and partial tracings of the type of *Lomaria Schiedeana*. The latter is smaller, more membranous, and the pinnae are more curved. Liebmann says that Schiede found but fragments of the sterile frond. At all events the differences are no greater than in the plants included in *S. striata;* in fact, the range in the apical reduction of the frond and in the shape and number of the pinnae is about the same.

Our material representing *S. Schiedeana* is very scanty; Liebmann had the advantage of knowing this region, and there seems to be no strong reason for not accepting his conclusion that *Schiedeana* and *longifolia* should be united. Both names were based on numbered type specimens; *longifolia* is, as Liebmann points out, a homonym; *Schiedeana*, however, was published twelve years earlier and is therefore the rightful name of the species, and Liebmann's name *spectabilis* is reduced to a synonym of *S. Schiedeana*. Liebmann's own sheets of *spectabilis* (U. S. National Museum no. 591311 and 591312) do not have the shining surface mentioned in his description of *L. spectabilis*. Otherwise, except for their smaller size, they seem to be very like the larger specimens included in *S. Schiedeana*.

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* Not the same as *von Türckheim 353* under *S. costaricensis*.

† *Lomaria longifolia* Kaulf. 1824; since transferred to *Stenochlaena;* var. 2 of *S. sorbifolia*, according to Christensen.

Christensen makes these three names (*Schiedeana*, *longifolia*, and *spectabilis*) synonyms of *Lomaria ornifolia** Presl. Presl published *L. Schiedeana* five years after *L. ornifolia;* in comparing them he described *ornifolia*, thought to be from Peru, as differing in having obliquely cordate bases; *Schiedeana* he elsewhere described as having elliptical-obtuse, not subcordate, bases. There seems therefore no reason for adopting *S. ornifolia* as the specific name for these plants which possess rounded to almost tapering bases.

Fée's *L. acrodonta* has apparently an abnormal fertile frond; not having access to the type, *Schaffner 102*, 1854, I see no valid reason for separating it from *S. Schiedeana*, especially as the description contains contradictory statements as to size. In the Rovirosa specimen included in *S. Schiedeana*, the fertile frond has in two places a pair of fertile pinnae instead of the usual single pinna. Such abnormality has not been noticed in any other species of *Struthiopteris*.†

18. **S. sessilifolia** (Klotzsch) Broadh. comb. nov.

Lomaria sessilifolia Klotzsch; Christ, Bull. Boiss. II. 4: 1092. 1904.

Blechnum sessilifolia[*um*] C. Chr. Ind. Fil. 159. 1905.

Plants‡ terrestrial. Rhizome (not seen). Sterile fronds 1.5 m. long; stipes 50–82 cm. long, angulate, dull brownish, the scales lanceolate, 1.5–2 cm. long, 2–4 mm. broad, dull brownish, ragged (according to Christ, reddish straw-colored, very soft, and thread-like); lamina 96 cm. long, 29 cm. wide, oblong, not at all or but slightly reduced at the base (type A, without vestigial pinnae), very gradually reduced at the apex, the pinnae crowded, often opposite, the rachis grayish brown, with dull brownish, fibrillose, more or less appressed, and deciduous scales; pinnae 58–70-jugate, linear-oblong, mostly falcate, the apex attenuate, serrate, the base cordate, free throughout, and partly covering the rachis, 13–15 cm. long, 20 mm. wide; margins irregularly revolute; leaf tissue herbaceous (much rolled in the poorly preserved cotype seen), not araneous below, the costal scales lanceolate or ovate-lanceolate, light brown, rather numerous;

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* Rel. Haenk. 1: 51. 1825.

† See the discussion under *S. violacea* of spurlike growths at the bases of the fertile pinnae in some species of *Struthiopteris*, p. 380.

‡ This description is chiefly from the U. S. National Museum cotype of *L. sessilifolia*.

veins slightly grooved above, appearing below as distinct, fine lines slightly but not definitely raised, the vein spaces 10–13 to 1 cm., the vein apices often marked by delicate, irregular, deciduous, scalelike growths. Sporophyls at least 100 cm. long; stipe over 22 cm. long (complete stipe not seen); lamina 80 cm. long; pinnae about 60-jugate, 12–15 cm. long, 3–4 mm. wide, the apex with a sterile tip 2–4 mm. long, the base distinctly cordate and petioled, the petioles bearing throughout glandular swellings at the upper side where they join the rachis;* sporangia dark brown; indusium not very heavy, irregularly but quite fully lacerate, apparently quite persistent.

Cotype in the U. S. National Museum, no. 472015, 472016, collected "Sommet du Volcan de Poas," 2,644 m., Costa Rica, *Tonduz 10710*, November 1896.

If not distinct, this could well be considered a mainland form of *S. lineata*. It differs as indicated in the key, and also in having many more pinnae. The only island specimens of *S. lineata* having more than 40 pinnae are the peculiar ones from Santo Domingo which were mentioned under *S. lineata* as quite different from the rest of that species; they, however, do not resemble this plant collected by Tonduz, as they are much heavier in texture and have much narrower laminae.

19. **S. Shaferi** Broadh. sp. nov.

Plants terrestrial. Rhizome evidently large, the scales 1.5–2 cm. long, tufted, rigidly erect, linear, broader at the base, often abruptly so, yellowish brown with a definite dark brown center. Sterile fronds 32–42 cm. long; stipes 3–10 cm. long, smooth to somewhat angulate, straw-colored to brownish, the scales much as on the rhizome, shorter, loosely arranged or disappearing with age; lamina 16–35 cm. long, 14–18 cm. wide, oblong or broadly elliptical (young oblanceolate), abruptly reduced at the base (type D, without vestigial pinnae), usually not reduced at the apex, the terminal pinna 7–11 cm. long, the rachis with much smaller scales or naked; pinnae 10–15-jugate, narrowly oblong to almost linear, straight to somewhat falcate, ascending, 8–11 cm. long, 10–15 mm. wide (through the dilation or auricle), the apex acuminate, entire, the base broadly dilated and fully adnate to the rachis in the upper pinnae, in the lower ones narrowed suddenly below the expansion or auricle on the lower side of the pinna and

* Each petiole has therefore a peculiar shouldered appearance; a few of the lower sterile pinnae have the same glandular expansion of the petiole.

barely petioled; margins incompletely and very narrowly revolute, entire,* not cartilaginous, finely glandular with stalked glands;† leaf tissue coriaceous, gray-green or sometimes when dried yellowish brown, much as in *S. Werckleana*, the costal scales smaller or lacking; veins not raised, indistinct, not swollen at their apices, the vein spaces 15 or 16 to 1 cm. Sporophyls 67 cm. long;‡ stipes 18 cm. long; lamina 47 cm. long, abruptly reduced at the base, not reduced at the apex; pinnae 19-jugate, with a sterile apex 1–2 mm. long, the base decurrently adnate in the upper pinnae, sessile in the lower ones and rounded to cordate, 9.5–11 cm. long, 2–3 mm. wide; sporangia brownish yellow; indusium cartilaginous, fully and regularly lacerate to the base, the sides of the lacerations concavely hollowed, the edges finely fimbriate. [PLATE 27.]

Type in the New York Botanical Garden herbarium, collected at Camp La Gloria, south of Sierra Moa, Oriente, Cuba, *J. A. Shafer 8106*, Dec. 24–30, 1910.

20. **S. striata** (Sw.) Broadh. comb. nov.

Onoclea striata Sw. Syn. Fil. 304; 422. 1806.

Lomaria striata Willd. Sp. Pl. **5**: 291. 1810.

Lomaria Ryani Kaulf. Enum. Fil. 155. 1824.

Lomaria brasiliensis Raddi (?), Pl. Bras. **1**: 50. *pl. 72, 72 bis.* 1825.

Lomaria tuberculata J. Sm.§ Cat. Kew Ferns. 1856.

Blechnum capense Diels (in part), in E. & P. Nat. Pfl. **1**^{4}: 249. 1899.

Blechnum striatum C. Chr. Ind. Fil. 160. 1905.

Plants terrestrial. Rhizome at least 2.5 cm. thick, the scales 2–3 cm. long, 2–4 mm. wide, varying from dark fawn to burnt umber. Sterile fronds 35–125 cm. long; stipes 15–74 cm. long, clustered, angulate, usually light-colored, dull to shining, the scales lighter, otherwise as on the rhizome, very deciduous, fewer shapeless ones among them than in *S. lineata* or none at all, the

* Wholly entire; not even subserrately margined by the swollen vein apices. In this *S. Shaferi* affords a marked contrast to all the petioled species previously described.

† Numerous, tiny, stalked glands are found on the revolute margin. Nothing of the kind has been observed in any other specimens included in this paper. This material is fresher than any other seen (collected in 1911), and this fact may account for the presence of the glands. Conservatory specimens of *S. Underwoodiana*, to which *S. Shaferi* is most nearly related, do not possess similar glands.

‡ All of the following measurements refer to the single fertile frond seen.

§ According to Smith himself; Cat. Ferns Br. Gard. 40. 1857.

position of the fallen ones marked by points as in *S. lineata*; lamina 22–71 cm. long, 12–35 cm. wide, broadly lanceolate to broadly oblong (broadly ovate or elliptical in the smaller plants), not at all or slightly reduced at the base (type A, without vestigial pinnae), usually reduced gradually at the apex, not reduced in the smaller forms; pinnae 7–20-jugate, lanceolate to lance-oblong, straight or slightly curved in the outer half or near their apex (falcate in some of the smaller fronds only), 8–20 cm. long, 1.8–3 cm. wide, tapering gradually, if slightly, to the abruptly acuminate, serrate apex, the lower pinnae petioled, the base decidedly cordate; margins revolute; leaf tissue rigid-herbaceous to coriaceous,* the costae scaly, fibrillose, or naked, the under surface delicately but often fully araneous on the raised veins; veins distinct, definitely raised below, the vein spaces 12–16 to 1 cm. Sporophyls 40–175 cm. long; stipes 24–118 cm. long; lamina 48–64 cm. long (16–23 in the smaller forms), reduced at the apex, but slightly reduced at the base; pinnae 15–27-jugate (7–15 in the smaller forms) with a sterile tip 5–10 mm. long which is often serrate, the lower petioled and cordate at the base, 7–18 cm. long, 3–6 mm. wide; often whitish-knobbed at the vein ends as in *S. vivipara;* sporangia yellowish brown to dark brown; indusium irregularly lacerate, often to the base.

TYPE LOCALITY: Martinique, St. Kitts (St. Christopher).

DISTRIBUTION: St. Kitts, Montserrat, Guadeloupe, Dominica, Martinique, St. Vincent, and Grenada.

SPECIMENS INCLUDED: ST. KITTS: Forest slopes of Mt. Misery, *Britton & Cowell 511*. GUADELOUPE: (Definite locality not given), altitude 700–900 m., *Duss 4353* (N, no. 524250; Y). DOMINICA: Laudat, *Lloyd 190* (small form, Y). MARTINIQUE: "Bois de la montagne," Pelée, altitude 600–1,000 m., *Duss 1555* (N, no. 524242, 524243; Y). GRENADA: *Sherring 137* (small form, Y, N).

In this as in *S. lineata* there are large and small forms. In both these species the field notes are too scanty to help explain these differences. Small forms have been seen from Guadeloupe, Dominica, Martinique, and Grenada. The Elliott and the Sherring specimens from Grenada have broadly elliptical-oblong to almost square laminae, with curved lower pinnae. These

* Markedly coriaceous in but one plant from St. Vincent ("Souffrière," 2,200 ft. in lava, *Eggers 6911* N), which differs also in having crowded overlapping pinnae which are deeply cordate; the wide fertile pinnae are somewhat abnormal, having cordate, sterile bases. (See also footnote under *S. violacea*, p. 380.)

specimens are not at all reduced at the apex of the lamina; the other smaller forms are but slightly reduced at the apex.

Kaulfuss described *L. Ryani* from Montserrat Island, saying he had seen only young specimens. Despite the reddish woolly character of both surfaces, it probably belongs with *striata*, from which he separates it because of oblong, smooth tubercles on the rachis at the base of the petioles; the lower, bipinnatifid, fertile pinnae suggest that he had an abnormal frond.* Raddi describes his *L. brasiliensis* as intermediate between *lineata* and *striata*. In the shape of the blade and in the small number of pinnae it seems nearer the smaller *S. striata* plants.

21. **S. Underwoodiana** Broadh. nom. nov.

Lomaria Boryana of American authors, not of Swartz.

Blechnum tubulare Diels (in part), in E. & P. Nat. Pfl. 1^4: 249. 1899.

Plants terrestrial. Rhizome "a pronounced trunk,† though mostly underground," the scales 3–3.5 cm. long, linear, rigid, erect, shining, dark brown with a light margin, the whole appearing tobacco brown. Sterile fronds 85–100 cm. long; stipes 18–36 cm. long, often angulate, marked almost throughout by vestigial pinnae, the scales smaller, soon deciduous, suddenly broadened at the base, and mixed with tangled fibrillose deciduous ones, the position of the fallen ones marked by fine points as in *S. rufa;* lamina 58–70 cm. long, 25–32 cm. wide, oblong or broadly elliptical, abruptly reduced at the base (the lower pinnae 4–8 cm. long, type D, with vestigial pinnae), but little reduced toward the apex, the terminal pinna 10–12 cm. long; pinnae 20–30-jugate, narrowly lanceolate to narrowly oblong, straight or slightly curved near their apices, the apex gradually acute to acuminate, the upper pinnae broadly adnate or dilated on the lower side at their bases, the lower ones free in at least half the lamina, the bases never auricled, rounded, sessile to very short-petioled, 15–20 cm. long, 18–24 mm. wide; margins entire, not revolute; leaf tissue rigid-herbaceous,

* It is possible that the bipinnatifid character may refer to such an abnormality as that mentioned under *S. Schiedeana;* the whole genus *Struthiopteris* does not contain a single species with a bipinnatifid *sterile* frond.

† According to Professor Underwood; Jenman says it is one or more feet high. Professor Underwood thought that Jenman had modified this statement to include *L. Boryana* Sw., which has a caudex 2–3 feet high. A plant now growing at the New York Botanical Garden, which was brought back by Professor Underwood in 1903, has (January 1912) a densely scaly crown 3 cm. high and about 3 cm. broad.

smooth to shining below; costae* flattened on the under side, naked or with reduced scales, the surface never araneous; veins not raised below, the vein spaces 10–14 to 1 cm. Sporophyls (in the only complete one seen) 110 cm. long; stipes 30–40 cm. long, marked at least part way by vestigial pinnae; lamina about 67 cm. long, abruptly reduced at the base, somewhat reduced at the apex; pinnae about 30-jugate, 16–30 cm. long, 3–4 mm. wide, heavy, the upper ones decurrent on the lower side, the lower with occasional basal protuberances;† sporangia dark brown; indusium quite regularly lacerate, and occasionally so to the base. [PLATE 28. This illustration includes a tracing from one of Jenman's unnumbered specimens, showing the usual reduction of the basal pinnae in the sterile lamina.]

Type in the New York Botanical Garden herbarium, collected at New Haven Gap, Jamaica, altitude 5,500 feet, *L. M. Underwood 985*, February 4, 1903.

SPECIMENS INCLUDED: JAMAICA: Base of John Crow Peak, altitude 5,000–5,500 ft., *Underwood 2431* (Y). "Morse's Gap," *Harris 7598* (Y).

This species has long been confused with the species *Boryana* (*Onoclea Boryana* Sw.), originally described from Africa. The original illustration‡ shows a very different plant with fewer, short, elliptical, distant pinnae; the original description mentions an arboreous stem, four feet high, and ovate-oblong pinnae which are obtuse and 5–10 cm. long. Even the descriptions of this species by American authors have been influenced by those of the African *Boryana;* e. g., Jenman describes the Jamaican plant as having an arboreous trunk. It has therefore been necessary to describe the Jamaican species, giving it a new name, *S. Underwoodiana*, for Professor L. M. Underwood, who collected

* In the other species the costae are definitely raised on the lower side; in this the shining costae look as if smoothed or ironed down.

† See the footnote under *S. violacea*, p. 380.

‡ Bory de St. Vincent, Voy. 2, p. 194, *pl. 32;* a copy is in the Astor Library, New York City; a tracing has been placed in the New York Botanical Garden herbarium.

A small plant, probably *S. Underwoodiana*, was brought to the New York Botanical Garden conservatories by Professor F. S. Earle from Jamaica in 1902. It lived about nine years but never seemed vigorous. In 1911 it had a rhizome 3–5 cm. in diameter, 3 cm. high, and 7 sterile fronds less than 30 cm. high, which were 5–10-jugate only. There were no fertile fronds. The plant in size and number of the pinnae suggested *S. Shaferi;* the laminae were less reduced at the base than in *S. Shaferi*, and the pinnae could hardly be called auricled on the lower side.

the plant in Jamaica. The stem description given above is quoted from a letter by Professor Underwood. He brought back a specimen of the rhizome, but it could not be found during the writing of this paper. He mentioned it as growing "on the summit of the higher ridges, above 5,000 feet, and not common."

22. **S. varians** (Fourn.) Broadh. comb. nov.

Lomaria varians Fourn. Mex. Pl. **1**: 113. 1872.

Blechnum varians C. Chr. Ind. Fil. 161. 1905.

Plants terrestrial. Rhizome (not seen). Sterile fronds 60–90 cm. long; stipes 12 cm. or more (incomplete in the cotype at the New York Botanical Garden), apparently not angulate, maroon, the scales yellowish, early deciduous, narrowly triangular to linear, mixed with fibrillose ones; lamina 48–50 cm. long, 25–28 cm. wide, oblong, the base not reduced (type A, without vestigial pinnae), but slightly or not reduced at the apex, the terminal pinna almost as long as the lateral ones,* the rachis soon becoming naked; pinnae 15–20-jugate, straight, long-lanceolate to narrowly oblong, the apex serrate, rather abruptly long-acuminate, the base subequally rounded, free throughout, petioled, 19 cm. long, 2 cm. wide; margins cartilaginous, irregularly erose-crispate and not revolute; leaf tissue rigid-herbaceous, smooth; veins not raised, the vein spaces 15–18 to 1 cm. Sporophyls,† the stipes 15 cm. long, the "base densely chaffy with long scales," pinnae 25-jugate, with a sterile apex.

TYPE: *Bourgeau 1826;* Herb. von Heurck, no. 1420, Mexico, "Vallée de Cordoba," February 4, 1866 (Y).

DISTRIBUTION: Known from the type locality only.

23. **S. violacea** (Fée) Broadh. comb. nov.

Lomaria violacea Fée, Mém. Foug. **11**: 11. *pl. 5.* 1866.

Blechnum violaceum C. Chr. Ind. Fil. 161. 1905.

Plants terrestrial. Rhizome 2–4 cm. thick (seen only in small specimens), the scales short (5 mm. or less) umber or brown-maroon. Sterile fronds of two types, (1) short and ovate or broadly lanceolate, and (2) larger and oblong, 18–100 cm. long;‡

* Abnormal in the New York Botanical Garden type number; not reduced, however, in the type number seen either at Kew or Geneva.

† As given in Fournier's incomplete description. They are lacking in the New York Botanical Garden sheets.

‡ Fée says the length may reach 100 cm.; he figures one of the "smaller" specimens which measures 118 cm.; no scale is given, however.

stipes 4–50 cm. long, clustered, somewhat angulate, the color varying from black and reddish black to dark violet, shining where naked, the younger, at least, having scales which are seemingly viscid and which dry as straight or hooked projections (appressed in one large specimen); lamina 13–44 cm. long, 7–25 cm. wide, abruptly reduced at the base (type A, without vestigial pinnae), gradually reduced at the apex, the rachis soon becoming naked and shining; pinnae 12–50-jugate, oblong and lanceolate to narrowly oblong, often opposite below, 4–10 cm. long, 8–16 mm. wide, the apex acute,* obtuse or only apparently so in the thicker forms with rolled pinnae, the bases subcordate to cordate or unequally cordate, but 1–4 of the upper pinnae adnate, the rest free, and the lower petioled; margins usually revolute,† the pinnae themselves rolled in the heavier forms; leaf tissue coriaceous in the smaller forms, membranous to rigid-herbaceous in the larger ones, costae more or less scaly, under surface smooth;‡ veins raised below, sunken above in the coriaceous plants, the vein spaces 14–16 to 1 cm. Sporophyls 40–85 cm. long, but taller than the sterile in all complete specimens seen; lamina 20–37 cm. long; pinnae 11–25-jugate, 4–5 mm. wide, the apex obtuse or with a sterile tip 3–7 mm. long, the bases cordate, the lower pinnae distinctly petioled with spurlike protuberances;§ the margins of the very dark and heavy pinnae often with whitish spots corresponding to the vein apices; sporangia very dark brown; indusium irregularly lacerate.

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* Fée says "*tunc obtusiusculis, tunc acuminatis.*" Only the smaller specimens seen show the blunt tips.

† Irregularly so and serrate in a young, membranous plant from Dominica, *Lloyd 315.*

‡ Slightly araneous below in *Duss 3710.*

§ All the fertile fronds of *S. violacea* bear curious spurlike protuberances in or near the axils of most of the lower pinnae. They are plainly discernible to the naked eye and usually 2–5 mm. long. Similar spurs are found with some of the lower pinnae in a few of the petioled species: *S. vivipara, S. Christii* (very small), *S. chiriquana* (apparently brittle and deciduous), *S. Schiedeana* (few, but interesting in connection with the twin pinnae seen in one specimen), *S. striata* (in the peculiar volcanic specimen from St. Vincent only, and as flattish glandular areas), and in *S. Underwoodiana.* Fertile fronds of *S. danaeacea* and *S. varians* were not accessible after this character was noted. It does not occur in any of the non-petioled species. (It is present in the fertile lamina of U. S. National Herbarium no. 575235, but there are indications that it does not belong with the sterile one on that sheet.) Hooker (Spec. Fil. **3**: 26. 1860) in speaking of the sterile frond of *L. spectabilis* remarks upon a "remarkable, rather large, and distinct black glossy *gland* exactly resembling except in color a very common scale insect. Were it more constant," he adds, "I would consider this a distinct species." No other reference to similar growths on the rachis, either fertile or sterile, has been found; the somewhat abnormal Panama plant included in *S. chiriquana* shows occasional, elongated, glandular areas on the sterile rachis.

TYPE: Fée, Mém. Foug. **11**: *pl. 5.* 1866; from Guadeloupe.

DISTRIBUTION: Known from Guadeloupe, Dominica, and Martinique.

SPECIMENS INCLUDED: GUADELOUPE: *Duss 4165* (Y), *Duss 3710* (Y). DOMINICA: Laudat, *Lloyd 315* (Y, N). MARTINIQUE: Montagne Pelée, *Duss 4163* (Y).

This species shows great variation in size, texture, and in the length and apices of the pinnae; most of the smaller coriaceous ones bear legends indicating that they are from high altitudes and the sides of volcanoes. Parallel information is wanting, however, for the larger specimens. The colored stipes and the heavy, lacerate, whitish-dotted fertile pinnae are apparently common to all mature specimens. Fée describes the sterile stipes as bearing short, remote spines, which are not present on our specimens or in his figure; the numerous projections figured on it resemble the dried, viscid scales described above.

24. **Struthiopteris vivipara** Broadh. sp. nov.

Plants terrestrial. Rhizome 3 cm. thick in the fragment seen, the scales very few, 2–2.5 cm. long, 4–6 mm. broad, brown umber, more or less plicate. Sterile fronds 85–90 cm. long; stipes 24–25 cm. long, angulate, vestigial pinnae present throughout, shining mahogany, the scales light brownish yellow, deciduous, shapeless and wholly appressed to the stipe, their attachment indicated as in *S. lineata;* lamina 64–66 cm. long, 28–30 cm. wide, oblong, abruptly reduced at the base (type A, with vestigial pinnae), not reduced at the apex, the terminal pinna 12–15 cm. long, viviparous at or very near the apex of the rachis; pinnae 15–16-jugate, oblong-lanceolate but broadest at the cordate base, straight or occasionally very slightly curved near the apex, the apex acute, never long-acuminate, the base cordate and free throughout, mostly sessile and the rachis covered by the bases of the pinnae, the lower pinnae petioled, 15 cm. long, 3–3.5 cm. wide; margins serrate, slightly or not at all revolute; leaf tissue rigid-herbaceous, the costae much like the stipe but also finely chaffy or fibrillose, the lower surface of the pinnae decidedly and finely araneous over the once forked veins; veins distinctly grooved above, raised below and more perpendicular than in most species of the genus (except the wider *S. striata* specimens), the vein spaces 12–14 to 1 cm. Sporophyls 115–125 cm. long; stipes 34–45 cm. long, vestigial pinnae barely visible; lamina 68–78 cm. long, abruptly reduced at the base, not gradually reduced at the apex; pinnae 15–17-

jugate, 15–17 cm. long, the terminal pinna 11–16 cm. long, 5–7 mm. wide, heavy, sometimes with a sterile apex 2–5 mm. long, the base cordate, petioled (lower 5 mm.), occasionally with spur-like protuberances;* the margins of the pinnae have whitish glands marking many of the vein apices as in *S. violacea;* sporangia very dark brown; indusium narrow, early deciduous, brittle, and very irregularly lacerate. [PLATE 29.]

Type in the U. S. National Herbarium, no. 575810, 575811, and in the New York Botanical Garden, collected on moist banks on the trail in the vicinity of La Palma, Costa Rica, altitude 1,450–1,550 m., *William R. Maxon 435*, May 6–8, 1906.

The type of *S. Christii* is from Costa Rica, but *S. vivipara* is evidently a very different plant. The following differences between the specimen mentioned under *S. Christii* (from Christ's herbarium) and *S. vivipara* may be noted: *S. vivipara* is oblong in shape and not reduced at the tip, the single specimen of *S. Christii* is ovate-lanceolate and gradually reduced at the tip; in *S. vivipara* the stipe and rachis are almost scurfy in appearance, owing to the fine, amorphous character of the wholly appressed scales; in Christ's sheet the scales are mainly definite, at least 1 cm. long, and appressed only at their bases, the stipes looking much like very scaly *S. lineata* stipes. The viviparous character may not prove constant, but it appears in each of the five fronds seen.

25. **S. Werckleana** (Christ) Broadh. comb. nov.

Lomaria Werckleana Christ, Bull. Boiss. II. 4: 1091. 1904.

Blechnum Werckleanum C. Chr. Ind. Fil. 161. 1905.

Plants terrestrial. Rhizome apparently subarboreous, the scales linear, 2.5–3 cm. long, shining, rigid, erect, with a darker center, tobacco brown to umber. Sterile fronds 115–140 cm. long; stipes† 58 cm. long, but slightly angulate, usually marked to the base with vestigial pinnae, the scales like those of the rhizome but smaller and soon deciduous; lamina 83–110 cm. long, 15–25 cm. wide, narrowly oblong, the base abruptly reduced (type A, with vestigial pinnae), gradually reduced at the apex, the rachis "spangled by scales" which are narrow, fibrillose, and mixed with *hoary* ones, forming fine, webbed masses on the rachis;

* See footnote under *S. violacea*, p. 380.

† All the following figures are the measurements of the only complete fronds seen: two sterile fronds and one fertile one; they are Wercklé's own specimens and from Christ's herbarium.

pinnae 35–50-jugate, narrowly oblong, the apex abruptly acuminate, slightly curved, not serrate, the base cuneate to somewhat rounded, petioled in all the lower ones, 12–15 cm. long, 13–17 mm. wide; margins entire, not revolute; leaf tissue coriaceous, yellowish below when dried; lower surface deciduously araneous with yellowish fibrillose scales, the costae also with fibrillose scales; veins not prominent yet distinct, the vein spaces 18–20 to 1 cm. Sporophyls 143 cm. long; stipes 66 cm. long; lamina abruptly reduced at the base; somewhat reduced at the apex; pinnae 40–50-jugate, 22–26 cm. long, 3–4 mm. wide, curved or twisted, heavy, very much reflexed in drying, the sterile (ventral) surface not visible; sporangia brownish yellow; indusium delicate, fawn to light tan, quite regularly lacerate to the base, the margin finely fimbriate.

TYPE: *Wercklé 169*, from Costa Rica.

DISTRIBUTION: Known from Costa Rica only.

SPECIMENS INCLUDED: Several sheets without collection number from Costa Rica collected by Wercklé, now in the U. S. National Museum (no. 575241, 575242, and 575243) and in the New York Botanical Garden.

This species is conspicuously different from any other species, both the sterile and the fertile fronds. Among the several characters given in the description the white or hoary, fibrillose scales of the rachis are perhaps the most peculiar, while the long, curved, fertile pinnae, very much lighter in color (sporangia and indusia) than in any other North American species, are the most striking.

Many foreign species have been incorrectly attributed to North America; e. g., even American writers have included in their local flora *Lomaria attenuata* Willd., *L. procera* Spreng., and *L. Schomburgkii* Klotzsch. The tonguelike tips and bases of the pinnatifid leaves of *attenuata* Willd. differentiate it from *S. polypodioides* with which it has been confused. Under *Lomaria procera*, Sprengel cites *Osmunda procera* Forst. The name was first used for a New Zealand species with remote or distant pinnae, which were ovate-oblong in shape. An early picture in Labillardière gives two forms of pinnae, neither of which resembles *S. lineata* or *S. striata* with which it is most commonly confused. A fragment of the type of *L. Schomburgkii* has such characteristic pinnae that it should not be made synonymous with any North American species; under it, however, Christensen places the species *L. rufa* Spreng. and *L. Ryani* Kaulf.

There is much need of more material from Central America;

except a few specimens from Guatemala there is very little from the region between Costa Rica and Mexico. Seven of the above twenty-five species have Costa Rica or Panama as type locality; for none of these, however, have we a sufficient number of specimens to be sure that our descriptions indicate the variation that might reasonably be expected. Much that we have is worth little because of its fragmentary condition; several of the specimens given under INQUIRENDAE are from this region.

The collections recently made by J. A. Shafer indicate that Cuba offers similar rewards and difficulties.

INQUIRENDAE*

1. One sheet from Costa Rica, *Pittier 1921*, "Forêts du Barba, versant Pacifique," 2,500–2,700 m., 1890 (N), with broad elliptical pinnae a little like *S. rufa* in shape, but differing in size, coloring, and in the serrate margin with definitely marked vein apices. A young specimen, U. S. National Museum no. 834094 ("Volcan de Poas, Alfaro, San José," Costa Rica, altitude 2,300 m., 1902), may belong with this.

2. One sheet from Costa Rica collected by J. J. Cooper, U. S. National Museum no. 154303, November 1886; the slender, fertile pinnae are 25–28 cm. long, and the sori are continued on the dilated, non-petioled, *decurrent* bases of the pinnae. No petioled species has such fertile fronds.

3. One sheet from Costa Rica collected by Wercklé 1901–1905; (the specimen is an unnumbered one from Christ's herbarium and bears the name *Lomaria procera*, below which is written Lysr.). The fibrillose midribs and rachis separate it from *S. costaricensis*, *S. lineata*, and *S. striata*, to which it is nearest. The fertile leaf is lacking, though I strongly suspect it is the one mounted with the sterile frond on the U. S. National Museum sheet no. 575235.

4. One sheet (part of a sterile leaf) from Costa Rica, collected by Wercklé, U. S. National Museum no. 575240, is wrongly labeled *B. Werckleana;* it differs from the description and Christ's other specimens in texture, color, proportion, the margin, the bases of the pinnae, and in size. A pinna was sent to Christ, but he

* This section includes only the unplaced material not already discussed in connection with the various species.

found the material too incomplete to name satisfactorily. With this might be placed another fragment (one pinna) from Costa Rica, *Hoffman 36*.

5. Two sheets from Guatemala, *Cook & Griggs 161* and *578*, near the Finca Sepacuite, Alta Verapaz (N); the long terminal pinnae suggest the smaller forms of *S. Schiedeana*, but they are heavier in texture and the bases of the pinnae are subcordate to cordate.

6. Two sheets (fragments) from St. Vincent, *H. H. & G. W. Smith 1023* (Y). Their coloring, their flattened, shining costae, which resemble those of *S. Underwoodiana*, and their falcate pinnae distinguish them from *S. striata*, which they otherwise suggest. They are not at all like the deeply cordate, coriaceous specimen from St. Vincent discussed under *S. striata*.

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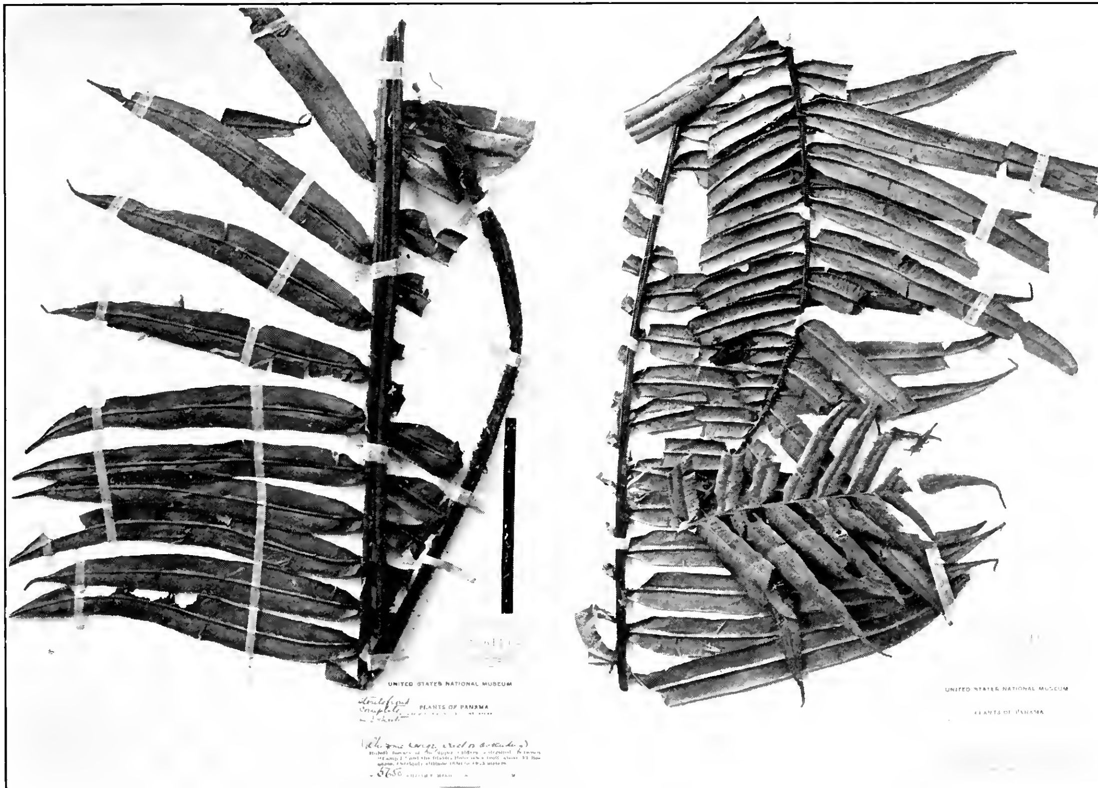
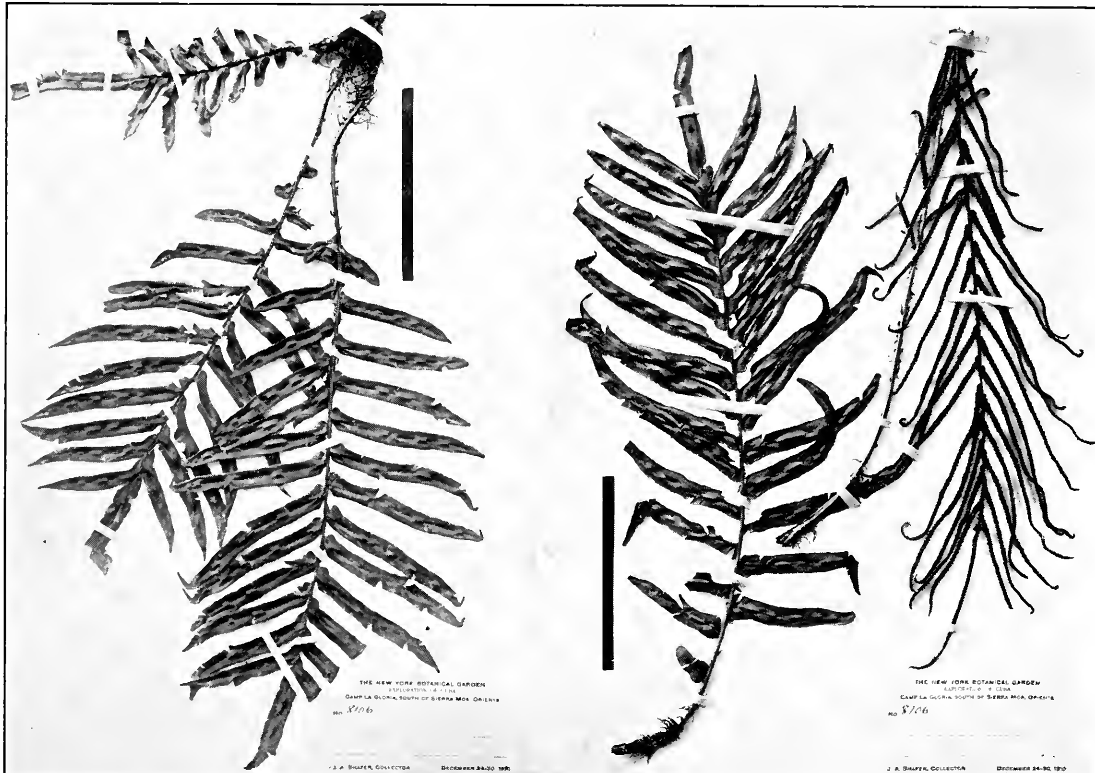


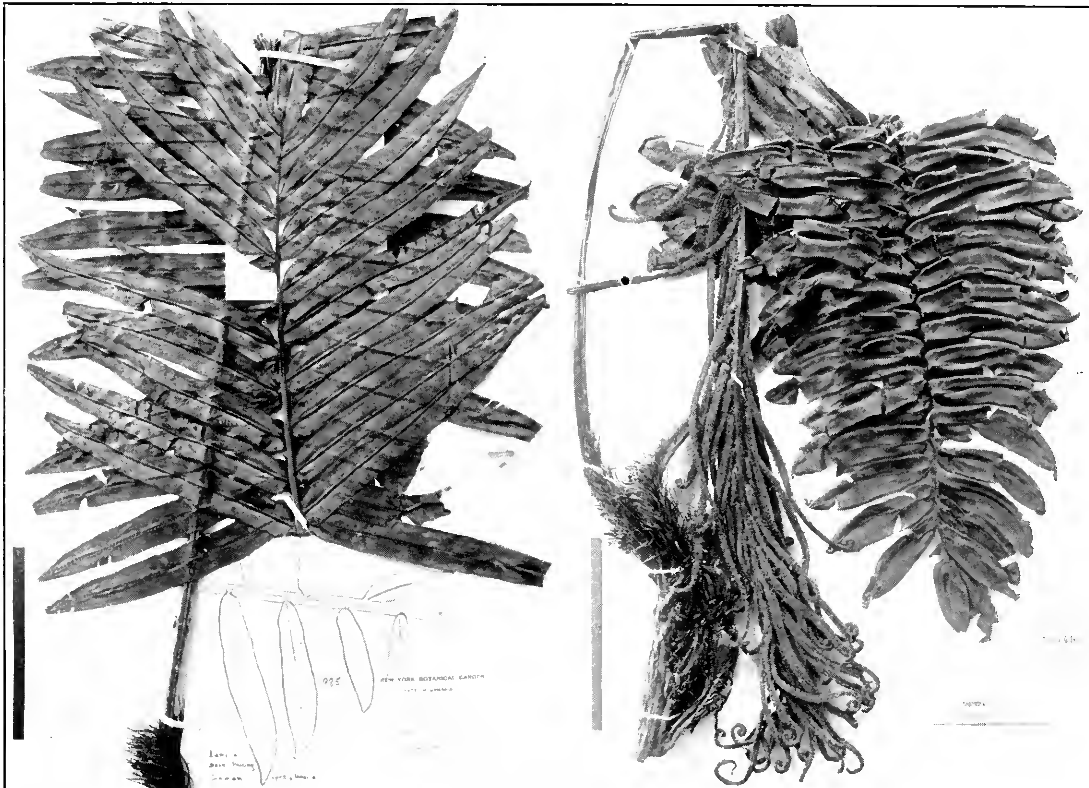
STRUTHIOPTERIS CHIRIQUANA Broadh. × 1/4.

(A scale 10 cm. long is shown on the sheet to the left.)



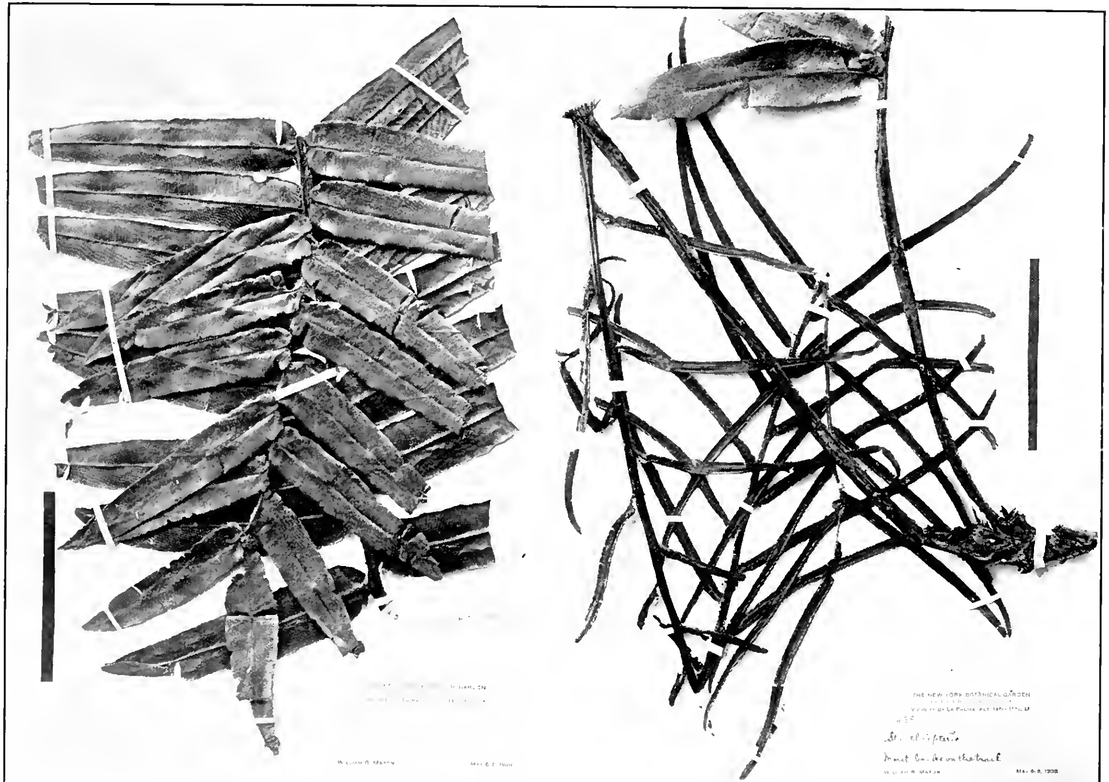
STRUTHIOPTERIS SHAFERI Broadh. $\times \frac{1}{4}$.

(A scale 10 cm. long is shown on each sheet.)



STRUTHIOPTERIS UNDERWOODIANA Broadh. STRUTHIOPTERIS RUFA (Spreng.) Broadh.

(Reduced to 1/4 of the actual size. A scale 10 cm. long is shown on each sheet.)



STRUTHIOPTERIS VIVIPARA Broadh. × ¼.

(A scale 10 cm. long is shown on each sheet.)

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By PER AXEL RYDBERG

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Studies on the Rocky Mountain flora—XXVII

PER AXEL RYDBERG

SALICACEAE

POPULUS HASTATA Dode, Extr. Mon. Gen. Populus (Mém. Soc. Hist. Nat. Autun 18:) 64. 1905

Some years ago we were forced to admit one of Dode's species, *P. Sargentii*. I say forced, because Dode's paper is presented in such an unscientific way that any one might feel inclined to ignore it altogether. His differentiations are based wholly on the leaf forms, and in very few genera do the leaves show so great variation as in *Populus*. In working over Mr. Butler's collection of Montana plants I found numerous specimens of a poplar which has usually been regarded as *P. balsamifera* L., sometimes as *P. trichocarpa* T. & G. A study of the fruit shows that this poplar has the sessile and 3-carpellary fruit and the large involucral cup of *P. trichocarpa*, but the capsule is proportionally longer than in that species and perfectly glabrous. The eastern *P. balsamifera* has evident pedicels and almost always 2-carpellary ovary and much smaller involucral cup. The leaves are usually broader than in *P. balsamifera* and often subcordate at the base. They resemble much those of *P. candicans* Ait. in outline but are perfectly glabrous. *P. candicans* has also pediceled and 2-carpellary capsules. It is apparent that this species represented by Butler's material is *P. hastata* of Dode, for he associated it with *P. trichocarpa* and pointed out just the characters by which it differs from that species. The name *hastata* was given in reference to the form of the young leaves, which he described as being hastate. His idea of the term hastate must have been rather strange, for he figured the different leaf forms, and the form of leaf illustrated as representing the young shoots is elongate-ovate with slightly cordate base.

It is represented in the herbarium of the New York Botanical Garden by the following specimens:

ALBERTA: Bow River, May 26, 1899, *McCalla 2236.*

MONTANA: Flathead Lake, July 23, 1900, *J. W. Blankinship;* Columbia Falls, September 14, 1892, *R. S. Williams* (both determined as *P. balsamifera candicans*); various localities in Montana, *Butler 124, 125, 126, 127, 128, 137.* To this may also belong the following, which are in leaf only: *Butler 112, 113, 114, 135, 147.*

IDAHO: Salubria, July 10, 1899, *M. E. Jones 6541* (labeled *P. trichocarpa*).

POPULUS BESSEYANA Dode, loc. cit. 38

Another poplar collected by Butler seems to be impossible to identify with any of the accepted species. Butler's material is all in leaf only, but there is in our collection one specimen collected by Miss Isabel Mulford, in Idaho, which evidently belongs here, and this specimen is in fruit. It is evidently related to *P. deltoides* Marsh., but the leaf shape is different and the pedicels are very short, shorter than the capsule. The young stems are perfectly terete, not at all angled; the bases of the leaves of the mature branches are rounded or subcuneate at the base and more or less serrate along the base; the basal glands are small and the petioles flattened. In *P. Sargentii* Dode the leaves are flabellate-cordate, with an open concave sinus at the base, which is toothless. The leaves resemble much *P. acuminata* Rydberg but are broader and less cuneate at the base, and in the latter species the petioles are terete. I adopt Dode's name, not because I can definitely identify it by his diagnosis but because his illustrations of the leaves resemble those of this species.

To this belong the following specimens:

IDAHO: Fish Haven, August 8, 1898, *Isabel Mulford 263.*

MONTANA: Delta of Flathead River, Big Forks, Montana, August 14, 1901, *Umbach 192;* and from several localities, *Butler 109, 111, 115, 116, 117, 120, 136, 139, 140, 144, 145, 149, 153.*

POPULUS FREMONTII Torr.

The known range of this species was extended last summer, when it was collected by Professor A. O. Garrett and the writer in and around the town of Moab, southeastern Utah; and specimens evidently also belonging to it were seen in the Cottonwood and White canyons about 100 miles farther southwest.

Willow hybrids are not uncommon in Europe and rather common in cultivation; but we find very rarely any references to any spontaneous hybrids of American species mentioned. It will therefore not be out of place to record the following specimens probably representing hybrids, although no definite proof can be given of their origin.

Salix cordata × S. monticola

The shrubs referred here have capsules shorter than in *S. cordata* Muhl. but longer than in *S. monticola* Bebb; the habit and the bark are those of the latter; but the narrow leaves (although less serrate) and the bractlets are those of *S. cordata angustata* (Pursh) Anders., the form of *S. cordata* common in the Rockies. The capsules of the specimens seen usually remained undeveloped. The staminate catkins resemble most those of *S. monticola*. *S. monticola* was growing mixed in with the supposed hybrid. *S. cordata angustata* is also growing in the Big Cotton Canyon, although no specimens of it were noticed in the immediate vicinity where the plants were collected.

UTAH: Big Cottonwood Canyon, below Silver Lake, July 11, 1905, *Rydberg 6877*, *6878*, and *6883;* July 4, 1905, *Rydberg & Carlton 6615*.

Salix glaucops × S. monticola

The specimens resemble *S. glaucops* Anders. in the capsules and bractlets, but the former are less densely hairy; the leaves are more like those of *S. monticola*, being finely serrate, glabrate in age and glaucous beneath; the young branches are somewhat villous. Both *S. monticola* and *S. glaucops* are growing in the Big Cottonwood Canyon.

UTAH: Big Cottonwood Canyon, Salt Lake City County, August 23, 1905, *A. O. Garrett 1671*.

Salix Sandbergii sp. nov.

Bark of the branches reddish chestnut brown, finely puberulent when young; leaves oval or elliptic, 2–4 cm. long, densely white-silky on both sides, grayish above, silvery beneath, entire or nearly so; pistillate aments sessile, naked, about 4 cm. long; bractlets purple, obovate-spatulate, 3 mm. long, white-pilose; capsule glabrous, 4–5 mm. long; stipe about 1.5 mm. long; style about 0.5 mm. long; lobes of stigma short.

The type was distributed as *Salix lasiolepis* Benth., to which it is not at all closely related. The leaves resemble somewhat those of *S. sitchensis* Sanson and *S. bella* Piper, but the capsule is glabrous and the plant belongs to the *S. cordata* group. On account of the white leaves it would be placed next to *S. Hookeriana* Barrett, but the leaves are silky, not villous, and entire, and the aments and capsules are much smaller. It grows on banks of streams.

Idaho: Valley of Hatwai Creek, April 28, 1892, *Sandberg, MacDougal & Heller 71* (type, in herb. N. Y. Bot. Garden).

The following species of willows are here recorded for the Rocky Mountain region: *Salix erythrocoma* Barrett (*S. arguta erythrocoma* Anderson), *S. lucida* Muhl., *S. Hookeriana* Barrett, *S. conjuncta* Bebb, *S. MacCalliana* Rowley, *S. alexensis* (Anders.) Coville, *S. Barrettiana* Hook., *S. Seemanii* Rydb., *S. Drummondiana* Barrett, *S. arbusculoides* Anders., *S. desertorum* Richards., *S. saskatchewana* Seem., and *S. Fernaldii* Blankinship, from the Canadian Rockies south of the 55° parallel; and *S. conjuncta* Bebb and *S. Fernaldii* Blankinship also from Montana.

ULMACEAE

Celtis rugosa sp. nov.

A tree, 5–10 m. high, with rounded crown; bark gray, corky; twigs brownish, pubescent when young; petioles 6–10 mm. long; leaf blades broadly ovate, oblique, 4–7 cm. long, somewhat cordate at the base, short-acuminate, sharply serrate except at the base and at the apex, coriaceous, dark green, very shiny and slightly scabrous above, brownish or yellowish green, dull, puberulent beneath, strongly reticulate and rugose; pedicels 15–25 mm. long; fruit globose, about 8 mm. in diameter, brownish; style short but evident.

This species is related to *C. reticulata* Torr. but differs in its longer pedicels (in *C. reticulata* 1 cm. long or less) and in its serrate, short-acuminate leaves, which are less pubescent, more shiny, and much less rough above. It grows in gulches and mountain valleys of Colorado.

COLORADO: Golden, Aug. 29, 1895, *P. A. Rydberg* (herb. N. Y. Bot. Garden); Aug. 30, 1895, *C. L. Shear 3263;* gulch west of Pennock's mountain ranch, May 26, 1897, *C. S. Crandall 2254.*

Celtis occidentalis L. is included in the Rocky Mountain flora by Coulter & Nelson,* but erroneously so, the writer thinks. *Celtis Douglasii* Planchon, *C. rugosa*, and perhaps also *C. reticulata* Torr. have been mistaken for it.

URTICACEAE

Urtica strigosissima sp. nov.

Perennial, dioecious; stem 1 m. high or more, glabrous below, strongly retrorsely strigulose above, but almost without bristles; stipules narrowly linear-lanceolate, acuminate; petioles 2–3 cm. long; leaf blades lanceolate, 3–5-ribbed, sharply serrate, rounded or acute at the base, long-acuminate at the apex, 5–10 cm. long, 1.5–5 cm. wide, finely strigulose beneath; flower clusters slender, the upper almost equalling the leaves; sepals ovate, about equalling the achenes.

This species resembles *U. gracilis* Ait. in habit and leaf form, but is more strigose and rarely at all bristly. In pubescence it resembles *U. Breweri* S. Wats. but has narrower leaves and narrowly linear-lanceolate, acuminate, instead of oblong and obtuse, stipules. It grows on river banks at an altitude of 1,000–2,500 m.

IDAHO: Forest, Nez Perces County, July 29, 1896, *A. A. & E. Gertrude Heller 3475* (herb. Columbia University).

Urtica viridis sp. nov.

Perennial with a horizontal rootstock, dioecious; stem 1–1.5 m. high, slender, glabrous or sparingly bristly, round-angled; stipules linear-lanceolate, acuminate, 5–8 mm. long; petioles short, one fifth to one third as long as the leaf blades; these from narrowly lanceolate to ovate, coarsely toothed, 4–10 cm. long, thin, light green, almost glabrous; panicles many-flowered, often equalling the upper leaves: sepals oval or ovate, usually half longer than the achenes.

* New Man. Bot. Cent. Rocky Mts. 143.

This species is closely related to *U. cardiophylla* Rydb. but differs in its narrower leaf blades, shorter petioles, longer and denser inflorescence, and longer sepals. In habit it closely resembles *U. gracilis* but differs in its practically glabrous stem and thinner and more glabrous leaves.

MONTANA: Emigrant Gulch, Aug. 23, 1897, *Rydberg & Bessey 3935* (type, in herb. N. Y. Bot. Garden); Jack Creek Canyon, July 15, 1897, *3936;* Jocko Creek, June 10, 1901, *D. T. MacDougal 275;* Melrose, July 6, 1895, *P. A. Rydberg 2612;* Lima, Aug. 6, 1895, *Rydberg 2613*.

WYOMING: Halleck Canyon, July 4, 1900, *Aven Nelson 7444*.

IDAHO: Priest Lake, July 28, 1900, *D. T. MacDougal 235;* Cooper's Warm Springs, July 1892, *Isabel Mulford*.

ALBERTA: Rocky Mountains, 1858, *E. Bourgeau*.

Parietaria occidentalis sp. nov.

Annual; stem slender, erect, simple or branched at the base, long-villous, 1–4 dm. high; leaf blades thin, light green, lanceolate, acute at the base, obtuse at the apex, 1–4 cm. long, 5–18 mm. wide, sparingly pubescent; bracts of the involucre linear, obtuse; sepals oblong or lance-oblong, obtuse or acutish.

This species is related to *P. pennsylvanica* Muhl. but differs in the long hairs of its stem, light green color, and the more obtusish sepals. It grows in moist shaded places.

IDAHO: Clearwater River, Nez Perces County, May 14, 1892, *Sandberg, MacDougal & Heller 176* (type, in herb. N. Y. Bot. Garden).

WASHINGTON: Wawawai, May 1897, *Elmer 755;* Alamota, June 1893, *Piper 1507*.

NEVADA: East Humboldt Mountains, August 1868, *S. Watson 1084*.

POLYGONACEAE

Eriogonum biumbellatum sp. nov.

Suffruticose perennial, branched at the base; leaves basal, clustered at the ends of the short branches, 2–5 cm. long, short-petioled; blades oblanceolate, finely tomentose on both sides when young, soon glabrate and green on both sides; scapes 2–3 dm. high, sparingly tomentose; involucres in compound umbels; bracts verticillate, similar to the leaves but smaller; involucres with a turbinate tube, which is about 2 mm. long, slightly tomentose; its lobes oblong, 1.5–2 mm. long, obtuse; perianth yellow, glabrous, 3–4 mm. long, with a stipelike base; divisions elliptic, obtuse, the outer slightly longer than the inner; filaments ciliate; ovary more or less hairy above, 3-angled.

This species is related to *E. umbellatum* Torr., *E. neglectum* Greene (*E. umbelliferum* Small), and *E. croceum* Small. It has the compound inflorescence of the last one, but the leaves are green and glabrate in age and much narrower than in the other species mentioned.

UTAH: Fish Lake around Twin Creeks, August 8, 1905, *Rydberg & Carlton 7376, 7409*, and *7483;* Fish Creek Canyon, August 2, 1909, *A. O. Garrett 2568.*

Eriogonum idahoense sp. nov.

Shrub 4–6 dm. high with gray bark; branches more or less tomentose, erect; leaves 2–3 cm. long, short-petioled; blades oblanceolate, white-tomentose beneath, loosely floccose and soon glabrate above; floral branches about 1 dm. high; inflorescence a compound trichotomous flat-topped cyme; involucres in the axils peduncled; peduncles of the lower forks 1 cm. long; branches of the cymes short, not over 5 cm. long; involucres turbinate, about 3 mm. long, floccose; lobes about 1 mm. long, lanceolate-oblong, obtuse; perianth yellow, glabrous, about 2 mm. long, without stipelike base; fruit unknown.

The type was labeled *Eriogonum microthecum* Nutt., which it resembles in habit, but the flowers are yellow instead of pink or white, and the lobes of the involucres are longer and not scarious-margined. It is more closely related to *E. orendense* A. Nels. and *E. campanulatum* Nutt. From the first it is distinguished by the leaves, which are glabrate above, the tall stem, and the more open inflorescence; from *E. campanulatum* by the tall shrubby habit and the tomentose involucre.

IDAHO: Wieser, July 7, 1899, *M. E. Jones 6511* (type, in herb. N. Y. Bot. Garden).

Eriogonum spathuliforme sp. nov.

Perennial, shrubby at the base, leaves all near the base; petioles 1–2 cm. long; blades elliptic to spatulate, 1–3.5 cm. long, white-tomentose on both sides, densely so beneath; stem scapiform, 2–3 dm. high, trichotomously branched, with ascending branches; bracts triangular, 5 mm. long or less; involucres in the lower forks short-peduncled, the rest sessile, glabrous, turbinate, 3 mm. long; lobes rounded, scarious-margined; perianth white, glabrous, 2–2.5 mm. long, campanulate; divisions equal, obovate; filaments slightly hairy below; ovary glabrous.

In habit and leaf form this species resembles *E. spathulatum* A. Gray, but the involucres are glabrous instead of tomentose, and the lower ones are peduncled; the stem is also perfectly glabrous. It differs from *E. tristichum* Small and *E. salicinum* Greene in its broader leaves and the scarious-margined lobes of the involucre. Jones' specimens are smaller and more cespitose than the type.

UTAH: Sandy washes near Belknap, June 12, 1900, *Stokes* (type, in herb. N. Y. Bot. Garden); Marysvale, August 30, 1894, *M. E. Jones 5969* (?).

Eriogonum depressum (Blankinship) Rydb. comb. nov.

Eriogonum ovalifolium depressum Blankinship, Mont. Agr. Coll. Sci. Stud. Bot. **1**: 49. 1905.

Eriogonum rubidum frigidum Gand. Bull. Soc. Bot. Belg. **42**: 194. 1906.

Dr. J. K. Small has for some years regarded this as a distinct species, and it is found in the herbarium of the New York Botanical Garden under a manuscript name of his, which, however, was never published.

Eriogonum ramosissimum Eastwood is related to *E. Wrightii* Torr. and does not belong to the *corymbosum* group, to which it was referred.

Eriogonum crassifolium Benth. is the same as the original *E. flavum* Nutt. What Coulter & Nelson and others have regarded as *E. flavum* should be known as *E. chloranthum* Greene. *E. aureum* Nutt. is the same, but the name was first published as a hyponym, and when finally it was properly published there was already an *E. aureum* Jones.

Torrey and Gray, in their revision of *Eriogonum*, described *E. strictum* Benth. as having subequal sepals, and they have been followed by S. Watson and others. Bentham, in his original description of the species, did not mention whether the perianth lobes are equal or not, but in his subsequent treatise of the genus in De Candolle's Prodromus he expressly stated that they are unequal. In the only two specimens found in the herbarium of the New York Botanical Garden, in my opinion belonging to *E. strictum*, the outer perianth lobes are very broadly oval while the inner are oblong. The species should therefore be associated with *E. dichotomum* Dougl. and not with *E. racemosum* Nutt. and *E. Wrightii* Torr., differing from the first principally in the glabrous involucres. Both *E. strictum* and *E. dichotomum* have been collected in Idaho.

The genus *Eriogonum* is represented by over one hundred species in the Rocky Mountain region. The following ones are not recorded either by Coulter & Nelson nor in my Flora of Colorado or in my Flora of Montana, but they should be included in the flora: *E. androsaceum* Benth. in Alberta, Montana, and British Columbia; *E. thymoides* Benth., *E. compositum* Dougl., *E. proliferum* Benth., *E. elatum* Dougl., *E. strictum* Benth., *E. spergulinum* A. Gray, and *E. vimineum* Dougl., in Idaho; *E. dichotomum* in Idaho and Montana; *E. micranthum* Nutt., *E. nidularium* Coville, and *E. Baileyi* S. Wats., in Idaho and Utah; *E. Porteri* Small, *E. pulvinatum* Small, *E. longilobum* M. E. Jones, *E. ochrocephalum* S. Wats., *E. villiflorum* A. Gray., *E. Shockleyi* S. Wats., *E. polifolium* Benth., *E. Thompsonae* S. Wats., *E. aureum* M. E. Jones, *E. spathulatum* A. Gray, *E. leptophyllum* Torr., *E. bicolor* M. E. Jones, *E. clavellatum* Small, *E. sulcatum* S. Wats., *E. Mearnsii* Parry, *E. ramosissimum* Eastw., *E. densum* Greene, *E. turbinatum* Small, *E. insigne* S. Wats., *E. deflexum* Torr., *E. nutans* T. & G., *E. Wetherillii* Eastw., *E. Thomasii* Torr., *E. subreniforme* S. Wats., *E. Parryi* A. Gray, *E. Ordii* S. Wats., *E. trichopodum* Torr., *E. angulosum* Benth., and *E. puberulum* S. Wats., in Utah; *E. Hookeri* in Utah and Wyoming; *E. tenellum* Torr. in Colorado; and *E. depauperatum* Small in the Black Hills of South Dakota.

Chorizanthe spathulata Small sp. nov.

A more or less branched annual; stem 5–20 cm. high, erect, strigose-canescent; branches erect, strict; lower leaves petioled, 1.5–3 cm. long; blades broadly spatulate, somewhat fleshy, hirsute-strigose on both sides, rounded and sometimes mucronate at the apex; stem leaves few, spatulate or oblanceolate, much smaller; bracts linear or linear-oblanceolate, arcuate-recurved, spinulose-tipped; involucre cylindroprismatic, 5 mm. long, angled and grooved, strigose; lobes 6, subulate, recurved, spinulose-tipped, the alternating ones somewhat narrower; perianth about 2 mm. long, lobes ovate; stamens mostly 3 (?); filaments adnate to the lower part of the perianth.

This species is related to *C. brevicornu* Torr., and Torrey and Gray included doubtfully Watson's specimens in that species.* It differs in its broader lower leaves and its strict erect branches.

IDAHO: Big Butte Station, June 23, 1863, *Edward Palmer 230* (type, in herb. Columbia University).

NEVADA: 1875, *J. G. Lemmon;* Big Bend of the Truckee, May 1868, *S. Watson 1044*.

CHENOPODIACEAE

Chenopodium pratericola sp. nov.

Annual; stem 3–6 dm. high, striate and angled, nearly glabrous; leaves petioled; blades oblong, lanceolate, or elliptic, 2–6 cm. long, 4–18 mm. wide, entire or with a short tooth on each side, usually callous-mucronate, green and nearly glabrous above, more or less mealy beneath, usually distinctly 3-nerved at the base; flowers in small clusters forming rather dense spikes or panicles; sepals scarious-margined, green on the back, slightly carinate; seeds easily separating from the pericarp, black, shining, about 1.5 mm. in diameter.

This has been included in *C. leptophyllum* (Moq.) Nutt. by most botanists although sometimes confused with *C. oblongifolium* (S. Wats.) Rydb. on account of its broad leaf blades. It differs from the former in its broader leaves, which are practically glabrous on the upper side, distinctly 3-nerved at the base, and at least the larger ones often toothed on the margins. From the latter it differs in its thin, more glabrate leaves and less dense inflorescence.

KANSAS: Riley County, August 2, 1895, *J. B. Norton 436* (type, in herb. N. Y. Bot. Garden).

NEBRASKA: Middle Loupe River, near Thedford, June 21, 1893, *Rydberg 1386;* Forks of Dismal River, July 11, 1893, *Rydberg 1835;* Kearney County, June 13, 1891, *Rydberg 318*.

MISSOURI: Courtney, June 25, 1896, *Bush 367*.

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* See Proc. Am. Acad. **8**: 196. 1870.

IDAHO: Lewiston, June 13, 1896, *Heller 3244*.

NEW MEXICO: Mesilla, June 3, 1897, *Wooton 84*.

WYOMING: Platte River, July 14, 1894, *Aven Nelson 483;* Snake River, 1900, *C. C. Curtis*.

ARIZONA: 1876, *Palmer 448*.

Chenopodium succosum A. Nels. is in my opinion a synonym of *C. rubrum* L., being the common American form thereof, and *C. desiccatum* is probably only a small form of *C. oblongifolium* (S. Wats.) Rydb.

Chenopodium lanceolatum Muhl. and *C. paganum* Reich., the former an eastern plant and the latter a European weed, both often erroneously known as *C. viride* L., have been collected in Colorado. The original *C. viride* L. is the same as *C. opulifolium* Schrad. of Europe, not known as occurring in this country. *C. viride* and *C. opulifolium* were based on the same illustration.

Monolepis spathulata A. Gray has been collected in Idaho.

Atriplex odontophora Rydb. is not a synonym of *A. canescens* (Pursh) James but of *A. aptera* A. Nels. instead.

Atriplex buxifolia sp. nov.

A suffruticose perennial; stem branched near the base, with simple branches, 3–4 dm. high; leaves sessile, elliptic or oval, thick, 1–2 cm. long; pistillate flowers in axillary clusters; fruiting bracts ovate, acute, 4–5 mm. long, toothed on the margins, with thick, often flattened processes on the faces.

This is related to *A. Nuttallii* but distinguished by its short oval or elliptic, often fascicled leaves, its simple wandlike branches and small fruit. It grows on dry plains at an altitude of about 1,200 m.

WYOMING: Dayton, Sheridan County, September 1899, *F. Tweedy 2656* (type, in herb. N. Y. Bot. Garden).

Atriplex tetraptera (Benth.) Rydb. comb. nov.

Obione tetraptera Benth. Bot. Sulph. 48. 1844.

This has usually been regarded as the same as *A. canescens* (Pursh) James but differs in its narrow, linear leaves, only 2–5 mm. wide, in its more strongly reticulate fruit wings, which have a broad sinus at the apex, and in that the free portion of the bracts is less than half as long as the width of the wing. It differs from *A. occidentalis* Torr. in its narrower and sharply toothed wing.

Atriplex Garretti sp. nov.

A low shrub, with straw-colored branches; leaves short-petioled, oval, 2–3 cm. long, grayish, scurfy on both sides, acute at the base, abruptly acuminate at the apex; flowers in axillary and terminal clusters; bracts about 8 mm. long and about as broad, 4-winged, coarsely toothed and occasionally with a few additional processes, with a broad open sinus at the apex; free portion 1–2 mm. long.

The fruit would associate this species with *A. canescens*, *A. occidentalis*, and *A. tetraptera*, but the leaves are quite different in shape. The plant looks in general habit somewhat like *A. confertifolia*, but the fruiting bracts are altogether different. It grows in arid valleys at an altitude of about 1,200 m.

UTAH: Vicinity of Moab, July 1, 1911, *Rydberg & Garrett 8465* (type, in herb. N. Y. Bot. Garden).

Endolepis phyllostegia (Torr.) Rydb. comb. nov.

Obione phyllostegia Torr. in Wats. Bot. King Exp. 291. 1871.

Atriplex phyllostegia S. Wats. Proc. Am. Acad. **9**: 108. 1874.

This species should be transferred from *Atriplex* to *Endolepis*, as sepals are present in the pistillate flowers.

Eurotia subspinosa sp. nov.

A dioecious shrub, 6–10 dm. high; branches ascending or spreading, becoming more or less spinescent, finely grayish stellate-tomentose but without longer hairs; leaves linear or oblong, obtuse, entire, 1–3 cm. long, or the secondary ones only 5 mm. long and comparatively broader, with revolute margins; flower clusters axillary, those of the staminate plant crowded and forming simple leafy spikes; fruiting bracts lanceolate, about 6 mm. long; horns usually about 2 mm. long.

This species is more decidedly shrubby than *E. lanata* (Pursh) Moq. and evidently always dioecious, has ascending or spreading branches, which become spinescent, lacks the long hairs intermixed with the stellate pubescence characteristic of *E. lanata*, and has usually longer horns. In *E. lanata* the branches are erect, and the plant is shrubby only at the base. The predominantly staminate plant has a few pistillate flowers borne on the lower part of the branches. The predominantly pistillate plant has often a few staminate clusters above but is sometimes wholly pistillate. *E. subspinosa* grows on rocky hills in the desert regions.

UTAH: Rocky summits, St. George, May 15, 1903, *Goodding 810* (type, in herb. N. Y. Bot. Garden); 1874, *C. C. Parry 725;* 1875, *E. Palmer;* April 9, 1880, *M. E. Jones 1642;* Virgin River, 1844, *Fremont 440.*

ARIZONA: Fort Verde, October 11, 1887, *E. A. Mearns 188;* Holbrook, August 10, 1897, *Myrtle Zuck;* Total Wreck Mine, 1903, *Thornber 60;* Rincon Mountains, October 7, 1900, *D. Griffiths 1781.*

NEVADA: Thousand Spring Valley, September 1868, *S. Watson 990* (in part); Muddy Valley, Lincoln County, May 6, 1906, *Kennedy & Goodding.*

CALIFORNIA: Mohave Desert, April 1905, *Mrs. C. DeKalb;* Radsburg, April 14, *A. A. Heller 7705;* Red Hill, west of Bishop, May 14, *A. A. Heller 8253.*

SONORA: Genaga di San Bernardino, 1855, *Schott.*

Dondia calceoliformis (Hook.) Rydb. comb. nov.

Chenopodium calceoliformis Hook. Fl. Bor.-Am. **2**: 126. 1838.

This, I think, deserves specific rank. It is characterized from *D. depressa* (Pursh) Britton and *D. erecta* (S. Wats.) A. Nels. by its broad and short, ovate or ovate-lanceolate bracts over 2 mm. wide.

AMARANTHACEAE

Amaranthus pubescens (Uline & Bray) Rydb. comb. nov.

Amaranthus graecizans pubescens Uline & Bray, Bot. Gaz. **19**: 317. 1894.

This probably deserves specific rank. It has been collected in Colorado.

Amaranthus carneus Greene and *A. californicus* S. Wats. should be added to the region. The former has been collected in Montana, and both in Idaho.

PORTULACACEAE

Limnia utahensis sp. nov.

Annual; stem 2–15 cm. long; basal leaves petioled; blades spatulate to linear, 1–3 cm. long, 2–6 mm. wide; stem leaves connate, forming an oblique, 2-lobed disk, 1–2 cm. broad; inflorescence very short, corymbiform; fruiting sepals ovate, acute, 2–3 mm. long, about equalling the pedicels; seeds about 1.5 mm. in diameter, minutely muricate.

This species resembles in habit *L. depressa* (A. Gray) Rydb. and *L. spathulata* (Dougl.) Heller but differs from the former in the long and narrow blades of the basal leaves and more connate stem leaves, from the latter in the large and broad stem leaves, and from both in the large seeds.

UTAH: St. George, 1877, *Palmer 56* (type, in herb. Columbia University); 1874, *C. C. Parry 23* and *24*.

I have not seen the type of *Montia Viae* A. Nels.,* but from the description and specimens named by Professor Nelson I judge it is the same as *Limnia depressa* (Robinson) Rydb.† published a few months earlier.

Coulter and Nelson report *Calyptridium roseum* S. Wats. from western Wyoming, but I think this must be a mistake.

Professor A. O. Garrett and myself collected *Talinum brachypodum* S. Wats. in southeastern Utah. Miss A. Eastwood has reported it from the same region.

ALSINACEAE

Cerastium thermale sp. nov.

Cerastium arvense fuegianum Hollick & Britton, Bull. Torrey Club **14**: 50. 1887. Not Hook. 1854.

Cerastium fuegianum A. Nels.; Coult. & Nels. New Man. Bot. Rocky Mts. 184. 1899.

Densely cespitose perennial; stems decumbent at the base, 5–10 cm. long, viscid-puberulent; leaves yellowish green, less than 1 cm. long, lanceolate, acute, or the lower oblong or spatulate and often obtuse, coriaceous, with a very thick midrib, finely viscid-puberulent; cymes 1–7-flowered, usually condensed and with short pedicels; sepals 4 mm. long, glandular-puberulent, ovate, scarious-

* Bot. Gaz. **42**: 48. 1906.

† Bull. Torrey Club **33**: 139. 1906.

margined; petals about 5 mm. long; capsule about 6 mm. long, slightly curved near the upper end.

This is *Cerastium arvense fuegianum* Hollick & Britton, but not that of Hooker. It differs from *C. strictum* L., its nearest relative, in the low, depressed stem, yellowish herbage, thicker and smaller leaves, the lower of which are often obtuse, and the smaller more condensed flowers. It grows on geyser formations in the Yellowstone National Park, at an altitude of about 2,000 m.

WYOMING: Lower Geyser Basin, Aug. 4, 1897, *Rydberg & Bessey 4025* (type, in herb. N. Y. Bot. Garden); Aug. 11, 1872, *J. M. Coulter.*

Alsine Palmeri sp. nov.

A cespitose perennial; stems several, spreading, 5 cm. high or less, glabrous; leaves ovate or ovate-lanceolate, 2–5 mm. long, fleshy, acute; cyme 3–7-flowered; bracts lanceolate, green; sepals lanceolate, 2.5–3 mm. long, acute; petals about equalling the sepals.

The type was named *Stellaria borealis* by Dr. Watson but is evidently not closely related to it. *A. Palmeri* has the thick leaves of *A. Edwardsii* (R. Br.) Rydb., but the midribs are not prominent, the flowers smaller, the sepals decidedly acute, and the petals only about equalling the sepals in length.

UTAH: Beaver Valley, 1877, *E. Palmer 54* (type, in herb. Columbia University).

Alsine alpestris (Fries) Rydb. comb. nov.

Stellaria alpestris Fries, Mant. 1: 10. 1832.

Alsine strictiflora Rydb. nom. nov.

Stellaria stricta Richards. Frankl. Jour. ed. 2. App. 15. 1823. Not *Alsine stricta* Wahlenb. 1812.

This is the *Stellaria longipes* of most western reports and of Coulter & Nelson's New Manual. It has a short pod and acute sepals, while the original *Stellaria longipes* Goldie has the pods twice as long as the obtuse sepals. If I am not mistaken the latter is the same as *Stellaria valida* Goodding.

Alsine subvestita (Greene) Rydb. comb. nov.

Stellaris subvestita Greene, Ottawa Nat. **15**: 42. 1901.

Arenaria cephaloidea sp. nov.

Somewhat cespitose perennial; stem strict, 2–4 dm. high, glabrous; leaves glabrous, erect, filiform-subulate, 3–10 cm. long; flowers in dense headlike cymes; bracts lanceolate, often 1 cm. long, scarious except the thick midrib, scabrous-ciliolate; sepals similar or somewhat broader, 4–5 mm. long; petals oblong, about half longer than the sepals.

This is related to *A. congesta* Nutt. but differs in its narrower bracts, which are wholly scarious, except the midrib, and scabrous-ciliolate on the margins; also in its larger flowers, stricter stem, and less cespitose base.

WASHINGTON: Spokane, Sept. 10, 1902, *O. Kreager 617* (type, in herb. N. Y. Bot. Garden); Clark Springs, July 17, 1902, *Kreager 100;* Loon Lake, July 20, 1897, *J. B. Winston*; Spokane County, June 27, 1884, *Suksdorf.*

IDAHO: Lake Coeur d'Alene, June and July 1892, *G. B. Aiton;* Little Potlatch River, June 2, 1892, *Sandberg, MacDougal & Heller 478.*

Arenaria lithophila Rydb. comb. nov.

Arenaria subcongesta lithophila Rydb. Mem. N. Y. Bot. Gard. **1**: 148. 1900.

This, I think, deserves specific rank. Some of the specimens recorded as *A. subcongesta* (S. Wats.) Rydb. should also be referred to it.

Alsinopsis dawsonensis (Britt.) Rydb. comb. nov.

Arenaria dawsonensis Britt. Bull. N. Y. Bot. Gard. **2**: 169. 1901.

This species has been collected in the Black Hills of South Dakota.

Alsinopsis pusilla (S. Wats.) Rydb. comb. nov.

Arenaria pusilla S. Wats. Proc. Am. Acad. **17**: 367. 1882.

This species has been collected in Idaho.

Arenaria laxiflora nom. nov.

Arenaria Fendleri diffusa Porter, Syn. Fl. Colo. 13. 1874. Not *A. diffusa* Ell. 1818.

Ammodenia oblongifolia (T. & G.) Rydb. comb. nov.
Arenaria peploides major Hook. Fl. Bor.-Am. **1**: 102. 1831.
Honckenya oblongifolia T. & G. Fl. N. Am. **1**: 176. 1838.
Arenaria sitchensis Dietr. Syn. Pl. **2**: 1565. 1840.

B. T. Butler has collected in Montana what seems to be *Arenaria laricifolia* L. At least it is the same plant as the one collected by Turner on the Porcupine River, Alaska, on the strength of which *A. laricifolia* is included in the American flora.

Sagina occidentalis S. Wats. has been collected in Idaho by Leiberg.

CARYOPHYLLACEAE

Wahlbergella Fries, Bot. Not. **1843**: 143. 1843

The treatment of the Silenoid genera of this family has been very different in this country and in Europe. S. Watson and B. L. Robinson admitted only two genera, *Silene* and *Lychnis*, while Pax* admitted beside *Silene* the genera *Lychnis*, *Melandryum*, and *Viscaria*, and Williams† admitted *Lychnis*, *Coronaria*, *Viscaria*, *Eudianthe*, and *Melandrium*. The only distinction given by Watson and Robinson is the number of styles, in *Silene* 3, in *Lychnis* 5, but Robinson admits that in some species of *Silene* the styles are sometimes 4 or 5. The number of styles is therefore not a very reliable character. Continental authors usually differentiate *Silene* from *Melandrium* (by Americans included in *Lychnis*) by the partially septate capsule of the former. According to Robinson this character is unreliable in our American species. Perhaps the species included in *Silene* without septum should be removed to *Melandrium* or to *Eudianthe*. As these doubtful species are not found in the Rockies, I shall give no opinion on them here. It is evident that the genus *Lychnis* as treated in America is an unnatural and composite group. Williams' treatment is perhaps the most logical. Pax included our native American species of *Lychnis* in *Melandrium* but divided the genus in three subgenera. One of these subgenera corresponds to *Eudianthe* with only 3 styles. The other two subgenera correspond to the original species of *Melandrium* and the genus *Wahlbergella* of Fries,

* Engl. & Prantl, Nat. Pflanzenf. **3**: 1*b*: 70, 73. 1889.

† Jour. Bot. **31**: 170, 171. 1893.

respectively. The typical species of *Lychnis* have 5-valved capsules with entire valves. In the typical species of *Melandrium* the valves are 2-cleft at the apex. In *Wahlbergella* the valves are also more or less notched. In that respect the species belong rather to *Melandrium* than to *Lychnis*. But the typical species of *Melandrium* are dioecious plants with ample long-exserted petals and of a different habit from that of our native species. These all have hermaphrodite flowers with very small and inconspicuous or even no petals. In my opinion the genus *Wahlbergella* should be taken up for our native species usually included in *Lychnis*. *Lychnis Drummondii* (Hook.) S. Wats. is somewhat different in habit and fruit and was referred to *Elisanthe* by Ruprecht, but I think it can well be included in *Wahlbergella*. Of course *L. striata* Rydb. is closely related to it and should be referred to the same genus, whatever disposition of it is made. The species of *Wahlbergella* in America are as follows:

Wahlbergella Drummondii (Hook.) Rydb. comb. nov.

Silene Drummondii Hook. Fl. Bor.-Am. **1**: 89. 1830.
Elisanthe Drummondii Rupr. Fl. Cauc. **1**: 200. 1869.
Lychnis Drummondii S. Wats. Bot. King Exp. 37. 1871.

Wahlbergella striata Rydb. comb. nov.

Lychnis striata Rydb. Bull. Torrey Club. **31**: 408. 1904.

WAHLBERGELLA TRIFLORA (Vahl) Fries, Summa Veg. Scand. 155. 1845

Lychnis triflora R. Br. Ross. Voy. App. CXLII (hyponym). 1819.
Melandrium triflorum Vahl, in Liebm. Fl. Dan. **14**[10]: 5. 1843.

Wahlbergella Taylorae (Robinson) Rydb. comb. nov.

Lychnis Taylorae Robinson, Proc. Am. Acad. **28**: 150. 1893.

WAHLBERGELLA AFFINIS (Vahl) Fries, Bot. Not. **1843**: 143. 1843
Lychnis affinis Vahl, in Fries, Nov. Mant. **3**: 36. 1842.
Melandrium affine Vahl, in Liebm. Fl. Dan. **14**[10]: 5. 1843.

Wahlbergella montana (S. Wats.) Rydb. comb. nov.

Lychnis montana S. Wats. Proc. Am. Acad. **12**: 247. 1877.

Wahlbergella Kingii (S. Wats.) Rydb. comb. nov.
Lychnis Kingii S. Wats. Proc. Am. Acad. **12**: 247. 1877.

Wahlbergella attenuata (Farr) Rydb. comb. nov.
Lychnis attenuata Farr, Contr. Bot. Lab. Univ. Pa. **2**: 419. 1904.

Wahlbergella Parryi (S. Wats.) Rydb. comb. nov.
Lychnis Parryi S. Wats. Proc. Am. Acad. **12**: 248. 1877.

WAHLBERGELLA APETALA (L.) Fries, Summa Veg. Scand. 155. 1845
Lychnis apetala L. Sp. Pl. **1**: 437. 1753.
Melandryum apetalum Fenzl; in Ledeb. Fl. Ross. **1**: 326. 1842.
Wahlbergella uniflora Fries, Bot. Not. **1843**: 143. 1843.

RANUNCULACEAE

Ranunculus rivularis sp. nov.

Ranunculus repens S. Wats. Bot. King Exp. 9. 1871.

A perennial with a fascicle of fibrous roots; stem hirsute, producing long stolons sometimes over 1 m. long, rooting at the nodes and there producing plantlets; leaves ternate, 5–15 cm. wide, divisions petiolate, ovate, usually truncate or subcordate at the base, 3-cleft and coarsely toothed; petals rounded-obovate, about 4 mm. long, scarcely equalling the sepals; head of fruit globose; achenes glabrous, beaks about one third their length.

The type was determined as *R. repens* L. by Dr. Watson, but is not so closely related to that species as to *R. Macounii* Britton. It was probably on account of the creeping and rooting habit that it was referred to the former. The small petals should at a glance have revealed the error, for in *R. repens* the petals are large and rounded, much exceeding the sepals. *R. Macounii* is occasionally decumbent but not rooting, and the outline of the leaflets or divisions is different and the beak about one half as long as the body of the achenes. My own specimens from Kimball, Nebraska, had stems over 1 m. long. It grows on wet river banks.

NEVADA: Huntington Valley, August 1868, *S. Watson 27* (type, in herb. Columbia University).

ARIZONA: Clark Valley, August 1883, *Rusby*.

NEBRASKA: Kimball, August 12, 1891, *Rydberg 7*.

TEXAS: 1851 *Wright 839*.

Thalictrum columbianum sp. nov.

A plant resembling *T. venulosum* Trelease in habit; stem 3–5 dm. high; leaves 2–4 times ternate, petioled except the uppermost; leaflets rather crowded, thick, and veiny, 1–2 cm. long, cuneate to nearly orbicular, 3-lobed and deeply toothed; inflorescence narrow; achenes oblong- or ovate-lanceolate, somewhat flattened, 4–5 mm. long, 1.5–2 mm. wide; veins strong, but not corky, and with broad and shallow grooves between.

The western specimens referred to *T. venulosum* by Dr. W. Trelease belong to this species, which differs mainly in the structure of the achenes, these approaching those of *T. megacarpum* Torr.

WASHINGTON: Loomiston, August 1897, *Elmer 599* (type, in herb. N. Y. Bot. Garden); Yakima County, 1892, *Henderson 2376.*

IDAHO: Pend d'Oreille River, 1861, *Lyall;* Lake Waha, July 1896, *A. A. & E. Gertrude Heller 3361;* De Lamar, July 7, 1892, *Miss Mulford.*

OREGON: 1886, *Cusick 1337.*

Delphinium Leonardi sp. nov.

A perennial with a tuberous root; stem 2–5 dm. high, viscid-pubescent, especially above; blades of the basal leaves 4–5 cm. wide, dissected into oblong, obtuse divisions, more or less viscid-pubescent; upper leaves with linear, acute divisions; lower pedicels 4–8 cm. long, ascending; sepals dark blue, oblong, obtuse or the upper acute; spur about 2 cm. long, slightly *s*-curved; upper petals whitish, veined with blue, emarginate; lower petals blue, with short lobes; follicles over 2 cm. long, curved, viscid-pubescent or in age glabrate; seeds dark brown, wing-margined.

It grows on river banks and beaches at an altitude of 1,800–2,400 m. It is related to *D. bicolor* Nutt. but differs in its longer spur, which is half longer than the obtuse instead of acute lateral sepals.

UTAH: Garfield, May 30, 1884, *Leonard 205* (type, in herb. N. Y. Bot. Garden); City Creek Canyon, April 21 and May 17, 1883, *Leonard 32* and *24.*

Delphinium coelestinum sp. nov.

A perennial with a short rootstock and strong woody roots; stem 3–5 dm. high, glabrous or slightly pubescent above, leafy; leaves long-petioled; blades about 3 cm. broad, sparingly pubescent, divided to the base into 3–5 narrowly cuneate divisions, these again cleft into linear-oblong, obtuse, mucronate lobes; sepals light blue, slightly pubescent outside, oblong, obtusish, about 1 cm. long; spur about 1 cm. long, usually somewhat curved; upper petals 8 mm. long, yellowish white, slightly lobed; lower petals light blue, with obtusish, wavy lobes; follicles 8–10 mm. long, slightly puberulent, nearly straight.

This species is related to *D. scaposum* but differs in its more leafy stem and in the more deeply dissected basal leaves with narrower segments. It grows in arid places.

UTAH: Southern Utah, 1877, *Palmer 11* (type, in herb. Columbia University).

ARIZONA: 1876, *Palmer 3*.

Delphinium xylorrhizum sp. nov.

A perennial with a stout woody root, related to *D. scaposum* but not at all scapiform; stem 2–3 dm. high, glabrous; leaves petioled, glabrous, fleshy; blades of the basal ones divided into 3–5 broadly cuneate divisions, these cleft and lobed with ovate or rounded lobes; stem leaves with linear-oblong lobes; sepals dark blue, oval, obtuse, pubescent outside; spur stout, about 15 mm. long; upper petals yellowish, about 7 mm. long, slightly cleft, with obtuse lobes; lower petals blue, with sinuate, obtuse lobes; follicles canescent-strigose.

This species differs from *D. scaposum* Greene in its leafy stem and its strigose follicles. It grows on clayey hillsides.

MONTANA: Lima, July 1, 1895, *Shear 3429* (type, in herb. N. Y. Bot. Garden).

Delphinium Helleri sp. nov.

A perennial with a short rootstock and fleshy roots; stem about 3 dm. high, viscid-pubescent throughout, few-leaved; leaf blades 3–5 cm. broad; the lower dissected into linear, obtuse divisions, more or less viscid-pubescent; the upper with narrowly linear, acute divisions; flowers few; the lower pedicels 4–6 cm. long, ascending; bractlets subulate, inserted some distance below the calyx; sepals dark blue, more or less pubescent, oval, about 15 mm. long; spur 2–2.5 cm. long, straight and attenuate; upper petals blue, tinged with yellow only on the lower edge, entire or slightly cleft, lower petals blue, with acute, crenate lobes; follicles viscid-pubescent, nearly straight, 2 cm. long.

This is related to *D. bicolor*, but the upper petals are dark blue and the spur is much longer.

IDAHO: Lewiston, April 1896, *A. A. & E. Gertrude Heller 2951* (type, in herb. Columbia University); region of Coeur d'Alene Mountains, June 24, 1895, *Leiberg 1031*.

Delphinium viscidum sp. nov.

Perennial with a woody root; stem about 3 dm. high, grayish strigose below, densely glandular-viscid above; leaf blades 5–7 cm. broad, densely grayish strigose, dissected into narrowly linear lobes; inflorescence branched; sepals dark blue, 12–15 mm. long, oblong, acute; spur 10–12 mm. long, somewhat *s*-curved; upper petals yellowish, tinged with blue, obtuse, entire; lower petals dark blue, with obtuse, sinuate lobes; follicles densely strigose.

This species is related to *D. multiflorum* and *D. reticulatum*, but the leaves are finely dissected as in *D. Geyeri* and *D. scopulorum*.

WYOMING: Near Tie Siding, July 6, 1896, *Osterhout* (type, in herb. N. Y. Bot. Garden); Evanston, August 1878, *Harry Edwards*.

BRASSICACEAE

Lepidium hirsutum nom. nov.

Lepidium intermedium v. *pubescens* Greene, Bot. Gaz. **6**: 157. 1880. Not *L. pubescens* Desv. 1814.

Lepidium medium pubescens Robinson, Syn. Fl. $\mathbf{1}^1$: 127. 1895.

Lepidium virginicum subsp. *texanum* v. *pubescens* Thell. Mitt. Univ. Zürich **28**: 230. 1906.

Physaria lanata (A. Nels.) Rydb. comb. nov.

Physaria didymocarpa lanata A. Nels. Bull. Torrey Club **31**: 241. 1904.

This, I think, deserves specific rank, but *P. grandiflora* Blankinship is nothing but the typical *P. didymocarpa*.

Radicula trachycarpa (A. Gray) Rydb. comb. nov.

Nasturtium trachycarpum A. Gray, Bull. U. S. Geol. & Geog. Surv. **2**: 233. 1876.

CHEIRINIA Link, Enum. Hort. Berol. **2**: 170. 1822

The type of the genus *Erysimum* (Tourn.) L. is *E. officinale* L., usually known under the name *Sisymbrium officinale* Scop. If the genus which has usually passed under the name *Erysimum* is regarded as distinct from *Cheiranthus*, it must be known under another name. The oldest available name is *Cheirinia*, with *Erysimum cheiranthoides* as the type. As I regard the Rocky mountain species well distinct generically from the wallflower of Europe, I adopt *Cheirinia* as the name for the genus.

CHEIRINIA CHEIRANTHOIDES (L.) Link, Enum. Hort. Berol. **2**: 170. 1822

Erysimum cheiranthoides L. Sp. Pl. 661. 1753.
Cheiranthus cheiranthoides Heller, Cat. N. Am. Pl. 4. 1898.

Cheirinia syrticola (Sheld.) Rydb. comb. nov.

Erysimum syrticolum Sheld. Bull. Torrey Club **20**: 285. 1893.
Cheiranthus syrticola Greene, Pittonia **3**: 136. 1896.

Cheirinia inconspicua (S. Wats.) Rydb. comb. nov.

Erysimum parviflorum Nutt. in T. & G. Fl. N. Am. **1**: 95. 1838. Not *E. parviflorum* Pers. 1807.
Erysimum asperum inconspicuum S. Wats. Bot. King Exp. 24. 1871.
Erysimum inconspicuum MacMillan, Metasp. Minn. Valley 268. 1892.
Cheiranthus inconspicuus Greene, Pittonia **3**: 134. 1896.

Cheirinia arida (A. Nels.) Rydb. comb. nov.

Cheiranthus aridus A. Nels. Bull. Torrey Club **26**: 351. 1899.

Cheirinia aspera (Nutt.) Rydb. comb. nov.

Cheiranthus asper Nutt. Gen. N. Am. Pl. **2**: 69. 1818.
Erysimum asperum DC. Syst. **2**: 505. 1821.

Cheirinia elata (Nutt.) Rydb. comb. nov.

Erysimum elatum Nutt. in T. & G. Fl. N. Am. **1**: 95. 1838.
Cheiranthus elatus Greene, Pittonia **3**: 135. 1896.

Cheirinia asperrima (Greene) Rydb. comb. nov.

Cheiranthus asperrimus Greene, Pittonia **3**: 133. 1896.

Cheirinia oblanceolata Rydb. comb. nov.

Erysimum oblanceolatum Rydb. Bull. Torrey Club **31**: 557. 1904.

Cheirinia Bakeri (Greene) Rydb. comb. nov.

Cheiranthus aridus Greene, Pittonia **4**: 198. 1900. Not *C. aridus* A. Nels. 1899.
Cheiranthus Bakeri Greene, Pittonia **4**: 235. 1901.
Erysimum Bakeri Rydb. Bull. Torrey Club **33**: 141. 1906.

Cheirinia argillosa (Greene) Rydb. comb. nov.

Cheiranthus argillosus Greene, Pittonia **3**: 136. 1896.
Erysimum argillosum Rydb. Bull. Torrey Club **33**: 141. 1906.

Cheirinia nivalis (Greene) Rydb. comb. nov.

Cheiranthus nivalis Greene, Pittonia **3**: 137. 1896.
Erysimum nivale Rydb. Bull. Torrey Club **31**: 558. 1904.

Cheirinia radicata Rydb. comb. nov.

Erysimum radicatum Rydb. Bull. Torrey Club **31**: 558. 1904.

Cheirinia Wheeleri (Rothr.) Rydb. comb. nov.

Erysimum Wheeleri Rothr. Rep. U. S. Geog. & Geol. Surv. **6** : 64. 1878.
Cheiranthus Wheeleri Greene, Pittonia **3**: 135. 1896.
Erysimum asperum alpestre Cockerell, Bull. Torrey Club **18**: 168. 1891.
Erysimum alpestre Rydb. Bull. Torrey Club **28**: 277. 1901.

Cheirinia amoena (Greene) Rydb. comb. nov.

Cheiranthus nivalis amoenus Greene, Pittonia **3**: 137. 1896.
Erysimum amoenum Rydb. Bull. Torrey Club **33**: 143. 1906.

Cheirinia Pallasii (Pursh) Rydb. comb. nov.

Cheiranthus Pallasii Pursh, Fl. Am. Sept. 436. 1814.
Cheiranthus pygmaeus Adams, Mém. Soc. Nat. Mosc. **5**: 144. 1817.

Hesperis pygmaeus Hook. Fl. Bor.-Am. 1: 60. 1830.
Erysimum pygmaeum J. Gay, Erysim. Nov. 4. 1842.

Cheirinia brachycarpa sp. nov.

Biennial; stem 3–6 dm. high, from a taproot, grayish canescent, somewhat striate; leaves all linear-spatulate or oblanceolate, 5–10 cm. long, sparingly canescent; the lower petioled and often minutely denticulate, the upper ones mostly entire; sepals oblong, about 1 cm. long, yellowish green; petals nearly 2 cm. long; claw long and slender; blades rounded-obovate, about 7 mm. wide, bright yellow; fruiting pedicels about 8 mm. long, strongly ascending; pods erect, 4–6 cm. long, 2.5 mm. thick; beak about 1 mm. long.

This species resembles *C. oblanceolata*, but the pod is much thicker and shorter and the flowers larger. It differs from *C. aspera* in its ascending, not divergent, and shorter pod. It grows on dry hillsides at an altitude of 2,500–3,000 m.

UTAH: Abajo Mountains, August 17–20, 1911, *Rydberg & Garrett 9713* (type, in herb. N. Y. Bot. Garden, flowers and young fruit); *9765* (well-developed fruit); Cottonwood Canyon, June 27 and July 1, 1905, *Rydberg & Carlton 6333* and *6570*.

Sophia leptostylis sp. nov.

Annual; stem 3–6 dm. high, rather simple below, sparingly stellate-pubescent or glabrous; leaves 3–10 cm. long, obovate in outline, twice pinnatifid, with oblong divisions, sparingly stellate-pubescent; the uppermost reduced and with narrower lobes; flowers numerous; sepals elliptic, yellow, 1–1.5 mm. long; petals spatulate, a little surpassing the sepals; pedicels in fruit 5–8 mm. long, spreading-ascending; pods about 5 mm. long, tapering to each end, nearly erect, somewhat curved; styles 0.5–0.7 mm. long; seeds more or less in two rows.

This resembles somewhat *S. procera*, especially in the form of the pods, but the inflorescence is more open and the pedicels more spreading. It grows at an altitude of 2,000–3,000 m.

UTAH: Big Cottonwood Canyon, July 4, 1905, *Rydberg & Carlton 6629* (type, in herb. N. Y. Bot. Garden); also June 29, *6498*, and July 8, *6806;* Big Cottonwood Canyon, June 1905, *Garrett 1361;* near Milford, June 22, 1905, *Rydberg & Carlton 6283;* mountains north of Bullion Creek, near Marysvale, July 23, *Rydberg &*

Carlton 6283; Fish Lake, August 2, 1909, *Garrett 2578;* Elk Mountains, August 8, 1911, *Rydberg & Garrett 9552;* Head of Dry Wash, August 11, 1911, *9628;* Mount Ellen, July 25, 1894, *M. E. Jones 5684g;* Logan Canyon, June 28, 1910, *C. P. Smith 2226.*

Arabis MacDougalii sp. nov.

Perennial; stem 4–6 dm. high, simple below, densely stellate-pubescent; basal leaves narrowly oblanceolate, 2–4 cm. long, entire or denticulate, densely stellate-pubescent; stem leaves linear or linear-lanceolate, sagittate at the base; sepals oblong, stellate-pubescent; petals white, oblanceolate, 5–6 mm. long; pedicels in fruit reflexed, 5–10 mm. long; pods finely stellate-pubescent, reflexed, 4–5 cm. long, 1.5 mm. wide; seeds in one row.

This species is related to *A. subpinnatifida* but differs in its smaller white petals and its entire leaves.

MONTANA: Old Sentinel, near Missoula, June 12, 1901, *MacDougal 191* (type, in herb. N. Y. Bot. Garden).

NEVADA: King Canyon, Ormsby County, June 4, 1902, *C. F. Baker 986* (referred here doubtfully).

Arabis brevisiliqua sp. nov.

Biennial; stems 3–4 dm. high, sparingly stellate-pubescent below, otherwise glabrous; basal leaves narrowly oblanceolate, 1–2 cm. long, finely stellate-pubescent; stem leaves linear, sagittate at the base, glabrous; sepals scarious-margined, 3 mm. long, glabrous or nearly so; petals purplish, about 6 mm. long; pedicels in fruit 3–5 mm. long, recurved pods 2–3 cm. long, 2 mm. wide, glabrous; seeds in two rows.

This species resembles *A. lignifera* A. Nels., but the pod is much shorter, less than 3 cm. long, with the seeds in two rows, and the sepals are glabrous instead of stellate-pubescent.

BRITISH COLUMBIA: Skagit Valley, July 6, 1905, *J. M. Macoun 70825* (type, in herb. N. Y. Bot. Garden); near international boundary, between Kettle and Columbia rivers, July 16, 1902, *J. M. Macoun 63496.*

ALBERTA: Trail to Lake O'Hara, August 8, 1904, *John Macoun 64517* in part.

Parrya platycarpa sp. nov.

Parrya macrocarpa S. Wats. Bot. King Exp. 14. 1871. Not *P. macrocarpa* R. Br. 1821.

Perennial with a stout caudex; leaves basal, runcinate, more or less glandular-hirsutulous, thick, 6–8 cm. long, oblanceolate in outline; scape 1–1.5 dm. long, glandular-hirsutulous; sepals oblong, 8 mm. long, saccate at the base; petals 15–18 mm. long, purplish; claws long, exceeding the sepals; blades obovate; fruiting pedicels 8–15 mm. long, ascending; pod erect, glandular-hispidulous, 3–4 cm. long, 6–7 mm. wide, acute at both ends, slightly constricted between the seeds, these broadly winged, 3–4 mm. wide.

This is characterized by its deeply lobed leaves, the hispidulous pubescence, the broad hispidulous pod, and the longer narrow petals with slender claws.

UTAH: Uintah Mountains, August 1869, *S. Watson 54* (type, in herb. Columbia University); also August 1889 and Aug. 11, 1890, *M. E. Jones*.

Smelowskia lobata sp. nov.

A densely cespitose perennial; earlier basal leaves cuneate or oblanceolate, merely lobed, with oblong divisions or even some of the earliest entire; the rest of the leaves pinnatifid, densely white stellate-floccose; stem 1 dm. high or less; sepals densely villous, 3 mm. long, ovate, acute; petals white, clawed; blades rounded-obovate; pod glabrous, about 5–6 mm. long, oblanceolate, tapering at the base; style very short.

This species has the pubescence of *S. ovata*, but the pod is tapering at the base. It has whiter and longer pubescence than *S. americana*, and the pod is much shorter. It differs from both in the shape of the earlier leaves.

ALBERTA: Northern Rocky Mountains, *Bourgeau*, Palliser Expedition (type, in herb. Columbia University).

MONTANA: Midvale, June 28 and July 9, 1903, *Umbach 206* and *325*.

MACKENZIE: *Richardson* (Franklin's Journey).

Draba pectinata (S. Wats.) Rydb. comb. nov.

Draba glacialis pectinata S. Wats. Proc. Am. Acad. **23**: 260. 1888.

This has been confused with *D. andina* Nutt. and *D. densiflora* Nutt., but it is easily distinguished by the leaves. They are scarcely stellate-pubescent, merely strongly ciliate on the margins and with an incurved tip. In the other two species the leaves are densely stellate-pubescent and their tips not incurved but spreading. The pods of *D. andina* and *D. pectinata* are nearly the same, but that of *D. densiflora* is larger and more elongated.

Nelson, in the New Manual of the Central Rocky Mountain Region, cited *Draba uber* A. Nels., *D. aureformis* Rydb., and *D. decumbens* Rydb. as synonyms of *D. luteola* Greene. The species he described under that name is evidently *D. aurea* Vahl, of which *D. uber* apparently is a synonym. *D. luteola* and *D. aureformis*, on the contrary, are closely related to *D. surculifera* A. Nels. but have light yellow flowers. A "conservative" botanist would unite the three. *D. decumbens* Rydb. is not closely related to either. Very likely Professor Nelson had not seen a specimen of the last named.

Fortunately, *Draba lapilutea* A. Nels. and *D. yellowstonensis* A. Nels. become synonyms of *D. praealta* Greene. *Draba deflexa* Greene has erroneously become *D. reflexa* in the New Manual.

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BIOCHEMICAL STUDIES OF SOILS SUBJECTED TO DRY HEAT

By FRED J. SEAVER and ERNEST D. CLARK

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BIOCHEMICAL STUDIES ON SOILS SUBJECTED TO DRY HEAT

FRED J. SEAVER and ERNEST D. CLARK

(*Laboratories of the New York Botanical Garden and of the Department of Biological Chemistry of Columbia University*)

(With plate 7)

INTRODUCTION

In our earlier communications on the relation of heated soils to the growth of plants we concerned ourselves only with the effects on the fungi, especially *Pyronema*. In our first paper[1] we reported that this fungus fails to develop on unheated soils, but can be made to thrive and develop abundant fruit on soils that have been heated. At that time it was suggested that heat seemed to produce chemical changes in the soil as well as to eliminate the competition of bacteria, other fungi, etc., with *Pyronema*. In the second paper[2] our experiments indicated that the inhibiting factor in unheated soils did not seem to be a toxin destroyed by heat, as had been claimed by Kasaroff. On the contrary, the better growth on soils which had been heated in an oven appeared to be parallel to the amount of soluble matter and to the depth of color of the water extract, both of which in turn were dependent upon the temperature to which the soils had been exposed. Temperatures of 125° to 180° C. gave very dark-colored extracts, with the odor of burnt sugar, due to the large amount of peculiar organic substances held in solution. Extracts obtained from such heated soils proved to be ideal culture media for *Pyronema* and others of the lower fungi, judging from the difficulty we had in keeping the extracts sterile. The addition of heated soil extracts to unheated soil did not render it favorable for *Pyronema* growth; and furthermore, analysis showed that

[1] Seaver: Studies on pyrophilous fungi. I. The occurrence and cultivation of *Pyronema*. Mycologia, 1: 131-139. 1909.

[2] Seaver and Clark: Studies on pyrophilous fungi. II. Changes brought about by the heating of soils and their relation to the growth of *Pyronema* and other fungi. Mycologia, 2: 109-124. 1910.

the unheated soil removed nearly all the soluble matter in the deeply colored extracts allowed to percolate through it. This interesting phenomenon has been noticed by us repeatedly, but whether it is due to chemical, physical or physico-chemical action we can not say. Since we first became interested in the effects produced by heating soil several other investigators have published the results of their studies on this subject. We have confined ourselves to the use of dry heat, while nearly all the others used steam heat.

DISCUSSION OF THE WORK OF OTHER INVESTIGATORS

At the Rothamsted Experiment Station in England, Russell and Hutchinson[3] studied the effects on soils produced by heating to a low temperature (98° C.) and by treatment with volatile antiseptics. Under these conditions they found that the fertility of the soil was enhanced and that this was due to an increase in the nitrogenous food thus made available. This effect seemed to be the result of the quickened activities of certain nitrifying bacteria not present to so great an extent in unheated soils. These authors' experiments show that the inhibition of the beneficial organisms in untreated soil is not due to a toxic substance, but that it is caused by the presence in untreated soils of large protozoan organisms which destroy the useful bacteria. Heat and antiseptics kill the protozoa and most of the bacteria, but the latter soon take a new lease of life from the unharmed spores, and finding themselves unattacked by their enemies, they reproduce in great numbers, meanwhile causing large increases in the soluble nitrogenous matter of treated soils. Experiments with crops demonstrated that the higher plants made growths on treated soils which were much better than on soils not treated. In summing up Russell and Hutchinson's work we may say that their idea is to credit the increased productiveness of heated and toluened soils to the consequent destruction of protozoa which in ordinary soils prey upon the beneficial ammonifying bacteria and nearly exterminate them.

Lyon and Bizzell[4] at the Cornell Experiment Station published

[3] Russell and Hutchinson: The effect of partial sterilization of soils on the production of plant food. Jour. Agric. Sci., 3: 111–144. 1909.

[4] Lyon and Bizzell: Effect of steam sterilization on the water-soluble matter in soils. Bull. 275. Cornell Experiment Station, Ithaca, N. Y. 1910.

a bulletin on the effects of steam sterilization, studying the chemical and agricultural phases rather than the bacteriological ones. Their soils were steamed for various periods of time in an autoclave under a pressure of two atmospheres. The water-soluble matter was greatly increased by this treatment, but upon standing untouched the soils gradually went back to their original state, at least as far as their soluble matter was concerned. These authors found that both ammonification and nitrification were absent for three months after heating. The extracts of these steamed soils were distinctly unfavorable to the growth of seedlings, but upon proper dilution the seedlings made a better growth than in extracts of unsteamed soils. They speak of the "injurious" results of steaming, but, of course, this term applies only when judged from the standpoint of the green plant. The lower fungi like *Pyronema* flourish on these extracts which are toxic to the seedlings of the higher plants. After standing three months the steamed soils made an excellent showing when planted with wheat. The fact that ammonification is at a standstill, and that such steamed soils are harmful to green plants immediately after this treatment, is probably attributable to the same cause, namely, the complete destruction of beneficial bacteria by the higher temperatures they employed. Russell and Hutchinson did not find this to be the case, probably because the temperature they used was sufficient to kill protozoa but not the spores of bacteria. This variation in temperature might well account for the differences in the results of these two groups of investigators. However, it is doubtful if it is correct to speak of the sterilization of a soil, since, as pointed out to us by Dr. Schreiner of the Bureau of Soils, it is impossible to say that the heat has entered the interior of the soil mass sufficiently to kill every living organism and spore. Fletcher[5] does not believe that the advantage of heating soils comes from changing the bacterial flora or increasing the soluble matter. He feels that the heat destroys some toxin present in the unheated soil. He heated soils to 95° and 170° C. and found that afterwards corn made a better growth upon both the heated soils than upon the unheated control. The work of other investigators and also our own does not agree with Fletcher's conclusion that soils heated to

[5] Fletcher: Effect of previous heating of the soil on the growth of plants and the germination of seeds. Cairo Science Jour., 4: 81–6. 1911.

a high temperature are favorable to an immediate growth of green plants.

Bolley[6] concludes that the destruction of the spores of disease-producing fungi and bacteria has more to do with the final increased productiveness on heated soils than has either the destruction of bacteria-loving protozoa, as claimed by Russell and Hutchinson, or the increase of soluble matter found by Lyon and Bizzell. There is undoubtedly considerable truth in this contention of Bolley. The authors of the present paper feel that the whole question of the effects of heating soils is a very complex one and one in which the experimenter's interpretation of results depends upon his training and point of view; whether it be bacteriological, chemical or phyto-pathological. It is very likely that the truth of the matter lies somewhere on the border-lines of the three sciences indicated.

PRACTICAL ASPECTS OF SOIL "STERILIZATION"

For some time a few gardeners and florists have found that heating the soil for the benches of their greenhouses seems to produce better plants, which were also free from the attacks of disease and from competition with weeds. In India, also, the Hindu farmers have long been in the habit of burning brush, cow-dung, etc., upon the surface of the rice seed-beds. They call this process "rab" and all speak highly of its efficacy in producing good crops. Mann[7] has discussed this practice and believes there are three main causes for its beneficial results: (1) Favorable changes in the bacterial flora of the soil; (2) organic nitrogenous matter is made more soluble; (3) the physical properties of the soil seem to be improved. Until within a few years the practice of heating soils in agricultural work had but few advocates; but now through the influence of the experiment stations and government bureaus it is being extended and applied in many directions.

Recently various bulletins and circulars have been published in different states and countries, advocating the "sterilization" of soils by heat, thereby freeing the crops from fungus and insect pests and also killing the seeds of weed plants. This treatment has been

[6] Bolley: Interpretation of results in experiments upon cereal cropping methods after soil sterilization. Science, 33: 229–34. 1911.

[7] Mann: Ann. Report of Dep't. of Agriculture, Bombay, pp. 50–4. 1908–9.

especially recommended in the case of seed-beds prepared for starting tobacco plants. Portable boilers with inverted pans and other apparatus for sterilizing the soil with steam have been described, and the results discussed in publications from the Connecticut Agricultural Experiment Station[8] and from the Bureau of Plant Industry at Washington.[9] In a bulletin[10] from South Africa the advantages of soil sterilization are called to the attention of the tobacco growers, the increase of plant food being especially noted. Burning brush or similar material upon the soil seems to yield better results than the use of steam. Now, in all these reports upon the favorable results of heating soils we find little reference made to any effects except the desirable ones of killing the spores of parasitic fungi, etc. The chemical changes that may be produced are almost wholly ignored, yet, even under the condition of the rather low heat obtained with the steaming apparatus, such changes apparently have a stimulative and beneficial action on the plants. Furthermore, we believe the almost universal practice of "sterilizing" the soil to be used in physiological and culture experiments should be applied with caution, and with due recognition that the resultant chemical changes in such soils may vitiate experimental results and prove more disconcerting than the undesirable factors in untreated soils.

Observers in certain districts in Maine and other parts of the country where blueberries flourish over large areas, have often noticed that when such areas have been recently burned over the growth was especially luxuriant. The Indians also noticed this phenomenon and so they occasionally set fire to large tracts of blueberry lands in order to encourage large crops of fruit in the following two or three summers. In northern New England, blueberries are picked in large quantities for canning, and in these districts the owners of blueberry pastures burn over one-third of such land every third year, thus burning over the whole once every three years.[11] The

[8] Hinson and Jenkins: The management of tobacco seed-beds. Bull. 166, Conn. Agric. Experiment Station, New Haven. 1910.

[9] Gilbert: The root-rot of tobacco caused by *Thielavia basicola*. Bull. 158, Bur. Plant Industry, Dep't of Agriculture, Washington. 1909.

[10] Scherffius: Sterilizing tobacco seed-beds. Agric. Jour. of Union of South Africa, 2: 418–31. 1911.

[11] Munson: The horticultural status of the genus *Vaccinium*. Bull. 76, Maine Agricultural Experiment Station, Orono. 1901.

attractiveness of the blueberry has often led to attempts to transplant and grow it under artificial conditions but failure usually followed. This was explained by assuming that the blueberry loved a peaty soil, a condition which could not be successfully imitated in gardens. However, Coville[12] has recently succeeded in growing the blueberry from seed and bringing it to full size and maturity. This was not done until a careful field study had shown that in nature this plant flourishes upon peaty soils which are *acid* in character. With this fact in mind Coville used well-drained acid soils, and by so doing he had unusual success in raising the blueberry. In the roots of the blueberry plant he discovered a mycorrhizal fungus that seemed to help supply the plant with nitrogenous food. In acid soils the ordinary nitrogen bacteria cannot develop, and this type of fungus may take their place in plants like the blueberry and the cranberry which thrive on acid peaty soils. In a later note Coville[13] reported that the Mayflower, or Trailing Arbutus, could be raised from seed when sown upon such acid soils, and could then be brought to a perfection of bloom seldom equalled in the wild state. We feel that there is some connection between these two observations that certain plants flourish upon acid soils and that many of the same kinds flourish on burned-over soils. In our earlier work we found that heating a soil produces in it easily soluble substances of acid reaction. It seems likely that burning over the underbrush on a soil renders it acid in reaction, and probably produces an artificially acid condition nearly as agreeable to certain plants as are the naturally acid peat soils. To test this point we now have experiments under way with seeds and cuttings of the blueberry, and also with the seeds of the Mayflower planted in soils rendered acid by heating.

ANALYTIC CHEMICAL STUDIES

In our previous paper the data for composition of the extracts of soils exposed to dry heat show that the amounts of soluble matter in the extracts are from six to ten times greater than in similar

[12] Coville: Experiments in blueberry culture. Bull. 193, Bur. of Plant Industry, United States Dep't of Agriculture, Washington. 1911.

[13] Coville: The use of acid soil for raising seedlings of the Mayflower, *Epigæa repens*. Science, 33: 711–2. 1911.

extracts of unheated soils. The organic matter thus made soluble is always greater in amount than the inorganic matter, but the latter is also considerably increased. We now turned our attention to a study of the effect of exposing the soil to different intensities of heat for the same period of time. The manner of handling the soil for these experiments was as follows: Ordinary loamy soil from this vicinity was placed in pots properly labeled with the various temperatures to which they were to be heated. They were all placed in a large hot-air sterilizing oven and were heated until the thermometer in the soil indicated 90°. This temperature was maintained for two hours, when the pot marked 90° was removed. The temperature was then increased to 120°, and maintained there for two hours, when the corresponding pot was taken out. This process was repeated in each case until the different series of heated soils were obtained. The extracts of the various soils were then prepared by percolating 3 kg. samples of the soils with about two liters of distilled water. We saved the first 350 c.c. that came through and used two 50 c.c. portions for the determination of soluble matter and total nitrogen. The remainder of each extract was reserved for cultural experiments with seedlings, etc.

TABLE I.

Effect of Different Temperatures upon the Soluble Matter in Soils

Nature of Soil	Total Solid Matter, Per Cent	Organic Matter, Per Cent	Inorganic Matter, Per Cent	Total Nitrogen, Per Cent
Unheated....................	0.030	0.020	0.010	0.0012
Heated to 90°...............	0.061	0.045	0.016	0.0016
Heated to 120°..............	0.117	0.092	0.025	0.0036
Heated to 150°..............	0.219	0.177	0.042	0.0092
Heated to 170°..............	0.275	0.184	0.091	0.0112

TABLE 2.

Conditions Similar to Those Stated in the Heading of Table 1

Nature of Soil	Total Solid Matter, Per Cent.	Organic Matter, Per Cent.	Inorganic Matter, Per Cent.	Total Nitrogen, Per Cent.
Unheated....................	0.030	0.015	0.015	0.0017
Heated to 90°...............	0.033	0.019	0.014	0.0022
Heated to 120°..............	0.049	0.034	0.015	0.0084
Heated to 170°..............	0.111	0.069	0.042	0.0106

To determine the soluble matter the 50 c.c. samples of each extract were evaporated to dryness in platinum dishes, dried at 108° to constant weight and this weight recorded as *total solids.* The residues were carefully ashed at a low red heat, dried and weighed again, and this weight recorded as *inorganic matter.* The difference between this weight and the weight of the total solids was recorded as *organic matter.* Total nitrogen was determined in another 50 c.c. portion by the official method for nitrogen, including that in the form of nitrates, etc.[14] The analytical results were very interesting. We give two typical series of such data in Tables 1 and 2.

From such figures one may conclude, as was done in our previous paper and in the papers of others, that dry heat causes the production in soils of large amounts of soluble material. The more striking fact is that the *increase of soluble matter goes hand in hand with the temperature to which the soil was subjected.* It occurred to us that the objection might be raised that in our experiments it was the *duration* of the heating rather than the temperature that caused the gradual increase of soluble matter in every one of our different series. To test this point we exposed one lot of soil to 120° for ten hours, and upon analysis of the extract it showed only a slight increase of soluble matter over the lot heated to 120° for two hours. The intensity of the heat seems to be the controlling factor in rendering the soil material more soluble. The organic matter, inorganic matter and total nitrogen all seem to be affected by the heat, but the organic matter and nitrogen show the greatest and most consistent increases. The color, odor and degree of contamination with *Pyronema, Penicillium,* etc., all show an increase parallel to the soluble matter indicated by analysis. In the next section our culture experiments show the same gradual change in the properties of the heated soil extracts dependent upon the degree of heating.

CHEMICAL NATURE OF THE SOLUBLE ORGANIC MATTER IN HEATED SOILS

We have already reported that the extracts of heated soils are acid to litmus, give the Molisch test for carbohydrates, reduce Fehling solution, and give a precipitate with lead acetate solutions.

[14] Official and provisional methods of analysis. Bull. 107 (rev.), Bur. of Chemistry, U. S. Dep't of Agriculture, Washington, 1908, p. 7, sec. (*c*).

This was the extent of our knowledge when we began the present study. Our first experiments were performed upon 200 c.c. of heated soil extract containing about 0.3 per cent. of total soluble matter. Its color was deep brown, its acidity was marked and it had an odor of burned sugar. To this hot extract an excess of basic lead acetate solution was added; this caused a heavy brown precipitate, which was filtered off and washed. The dark precipitate was suspended in distilled water and treated with hydrogen sulfid gas for the removal of the lead. The lead sulfid thus formed was filtered off and the clear brown filtrate was boiled to expel the excess of hydrogen sulfid. The filtrate after the removal of the first lead precipitate was yellowish and it, too, was saturated with hydrogen sulfid to remove the excess of lead. The lead sulfid was removed by filtration. The two solutions now free from both lead and hydrogen sulfid were then subjected to the tests indicated below:

	Molisch Test	Fehling–Benedict Solution	Alkaline Silver Solution	Color	Odor
Material *precipitated* by basic lead acetate...	Very strong	Reduction	Reduction	Brown	Sharp, caramel-like
Material *not precipitated* by basic lead acetate..........	Doubtful	Negative	Reduction	Yellowish	Sweet, not sharp

The solution of the material precipitated by basic lead acetate deposited a crystalline powder upon spontaneous evaporation to dryness. These crystals were insoluble in 95 per cent. alcohol, which dissolved the brownish coloring matter mixed with them. This treatment might afford a means of separating these substances. Dialysis through collodion membranes did not produce any separations in any of our chemical work upon any of the various soil extracts.

We next obtained a large volume of heated soil extract (2.25 l.) and added to it *normal* lead acetate solution until no more precipitate was produced. This precipitate was filtered off and *basic* lead acetate solution added to the filtrate until no further effect was produced. In this case the addition of the basic salt caused a precipitate which became lighter in color with each successive addition. This precipitate was removed by filtration and the clear yellow filtrate was saturated while hot with hydrogen sulfid. This was also done with suspensions of each of the two precipitates already obtained. The lead was removed as sulfid and the excess of hydrogen sulfid was boiled out. The three purified solutions were tested as follows, with the results indicated:

	Molisch Test	Fehling-Benedict Solution	Alkaline Silver Solution	Color	Odor
Material precipitated by *normal* lead acetate...	Weak	Reduction (?)	Reduction	Brown	Sharp
Material precipitated by *basic* lead acetate...	Very strong	Reduction	Reduction	Brown	Sweet
Material precipitated by *neither* reagent.	Very strong	Reduction (?)	Heavy precipitate	Light yellow	Sweet

Note. An attempt was made to prepare osazones from the solutions by the customary use of phenyl hydrazine and sodium acetate but dark amorphous products were always obtained.

The three solutions obtained, as described in the last paragraph, from the basic lead acetate precipitate, the normal lead acetate precipitate, and the final filtrate, were all evaporated to small bulk. With these solutions various attempts to make separations were ineffectual until we found that the addition of an alcohol-ether mixture or acetone produced light flocculent precipitates. Acetone yielding better results, we used it upon larger volumes of the three solutions. The acetone produced buff-colored precipitates of great bulk but containing little material when dry. They dissolved easily in distilled water. Such solutions showed little if any reduction of Fehling-Benedict solution, but gave strong Molisch tests in all cases. They gave reddish brown colorations with dilute solutions of iodin with potassium iodide.

From these chemical observations, then, it seems likely that the organic material in heated soil extracts consists mostly of carbohydrate-like substances, probably derived from the cellulose remains of previous plant growth upon the soil. Whatever may be the source of this material it seems to show properties of sugars and also of organic acids. The cellulose or humus substance seems to be changed by the heat into a series of decomposition products having the groups characteristic of sugars and also of organic acids. Precipitation with normal lead acetate and then with the corresponding basic salt produces a partial separation of these substances, as also does the addition of acetone. The relation of this organic material to the constituents of caramelized sugar would make an interesting study.

CROP EXPERIMENTS

Many experiments with the fungus *Pyronema* had shown that the stronger the extracts of heated soils the better media they were for this fungus. Other authors had reported that the green plants did not take kindly to soils which had been heated to a high temperature. From the above observations it occurred to us that the harmful effects from the heating of the soil in which certain plants are grown might not be due to the fact that the materials rendered available by heating are especially harmful, but that they are formed in such large quantities that the green plant is unable to use them. This view is strengthened by the experience of Livingston[15] and others that growth is accelerated in weak solutions and retarded in concentrated ones. On the other hand, the lower plants such as yeast and fungi are able to grow in solutions that would very rapidly plasmolyze the cells of the higher plants.[16] Evidently, then, the osmotic pressure of their cells must be in equilibrium with that of their medium. In order to test this conception as applied to our problem it was decided to try the effect of the growth of a given plant on the same kind of soil heated to different temperatures. In looking about for a plant to be used in these preliminary experiments, the common oat (*Avena sativa*) was selected for the reason that it had been previously observed that the burning over of the surface of the soil seemed to accelerate the growth of this particular crop.

[15] Livingston: The rôle of diffusion and osmotic pressure in plants, pp. 124–144. 1903.

[16] This matter is discussed in Jost's (Gibson translation) Plant Physiology, p. 179. 1907.

Experiment I. Ten pots of common unfertilized New York soil were prepared; two of these were kept as controls and two heated to a temperature of 90° C. for two hours, two to a temperature of 120° for the same length of time, two to 150° and two to 170° C. From one series of pots, extracts were taken by percolating equal amounts of distilled water through each pot. Approximately the same amount came through in each case. One hundred c.c. were taken from each pot to be used for analytical purposes. As has been previously noted, the extracts of heated soils are of a brown color. In this series of experiments it was observed that the color varied directly with the temperature; the control being colorless, the extract from the soil heated to 90° being slightly colored, the color becoming deeper in each case as the temperature increased. The results of the chemical analyses of these extracts are given in Table I (page 419).

The other series of pots of soil which had been similarly heated, but not extracted, were watered and planted with oats, the same number of seeds having been placed in each pot. After about two weeks the following results were obtained: the control and pot of soil heated to 90° showed practically the same growth; that heated to 120° showed considerable acceleration; and beyond this the growth was retarded, the retardation in the pot heated to 150° and that heated to 170° being nearly equal. The accompanying photograph (Plate VII) shows the control, the pot heated to 120° C. and that heated to 170°, the contrast being greatest at these points.

Experiment II. In order to check the results obtained in one of the experiments just described, a second series of pots of ordinary New York soil were set up and heated in the manner already stated. In this case the series consisted of an unheated control, and three others heated to 90°, 150° and 180° C. respectively. Oats were planted as usual and their condition noted, after germination and about two weeks' growth had been made. In this series the soil heated to 120° did not show the slight gain over the unheated control that was noted in the earlier experiments, but the higher temperatures produced the same retarding effects already found. In this and previous experiments the soils heated to 120° and above

SEAVER AND CLARK: GROWTH IN HEATED SOILS.

Left to right: Oats grown in unheated soil, in soil heated at 120° C., and in soil heated at 170° C.

were very soon covered with a luxuriant web of mycelium of *Pyronema* which produced its salmon-colored fruiting bodies and then disappeared. This is another illustration of the fact that conditions of media entirely unsuited for green plants may be highly favorable to fungi. One should be careful not to speak of "toxic" or "poisonous effects" unless the organism is mentioned to which such reference is made.

The cultural experiments just outlined show that heating soils to temperatures above 120° seems to produce effects unfavorable to the growth of oats, while heating to less than 120°, depending, of course, upon the crop and soil used, seems to be slightly beneficial or, at any rate, not definitely harmful. The harmful effects on green plants and the beneficial effects on fungi seem to increase, hand in hand, with the intensity of the heat. This may indicate that both effects are due to the relative *amounts* of substances in solution and not to their so-called harmful or beneficial nature. This parallelism is so complete that it does not seem likely that the effects of heating soils are mainly due to the destruction of *living organisms*—the protozoa mentioned by Russell and Hutchinson or the spores of harmful fungi according to Bolley. In other cultural studies we made extracts of similar series of heated soils for chemical analysis and for culture solutions in lupin experiments now to be outlined.

THE EFFECTS OF SOIL EXTRACTS UPON LUPIN SEEDLINGS

After satisfying ourselves that strongly heated soils were distinctly harmful to the growth of oats upon them, we then used extracts from series of soils heated to different temperatures for equal periods of time as culture solutions for lupin seedlings. These seedlings had been started in germinators filled with sphagnum moss and the radicle allowed to reach a length of 3–5 cm. The seedlings were placed in Jena beakers containing 200–300 c.c. of the extracts to be studied. They were placed on glass rods in lots of four in each extract after the manner described by True and Gies.[17] All measurements are given in millimeters of growth in the designated time and represent the average for *four* seedlings (Table 3).

[17] True and Gies: On the physiological action of some of the heavy metals in mixed solutions. Bull. Torrey Botan. Club, 30, 390. 1903.

TABLE 3. EXPERIMENT I. STARTED MAY 5, 1911

Growth, in Millimeters, of Lupin Seedlings in Soil Extracts

Nature of Extract	May 6	May 8	May 9	May 11
Unheated soil	15	43	15	28
Heated to 90°	15	48	12	24
Heated to 120°	10	24	8	11
Heated to 170°	7	17	3	4

Note. For analytic data pertaining to these extracts see page 419 (Table 2).

The appearance and growth of the lupins in the unheated soil extract and the 90° soil extract were apparently normal in every way. However, in the extracts of the 120° and 170° soils the opposite was true. The white roots very rapidly became brownish in color and the formation of secondary roots was almost entirely prevented. Such lupins looked like similar ones acted upon by toxic though minute amounts of copper. The results of another typical experiment upon the effects of the soil extracts are given below.

TABLE 4. EXPERIMENT II. STARTED APRIL 7, 1911

Growth, in Millimeters, of Lupin Seedlings in Soil Extracts

Nature of Extract	April 8	April 10	April 11	April 13
Unheated soil	7	24	16	26
Heated to 90°	5	22	15	26
Heated to 120°	2	16	12	20
Heated to 170°	4	12	8	12

Note. Whenever the extracts of heated soils were to be preserved for analysis or seedling studies, it was found necessary to seal them in glass-stoppered bottles while boiling hot.

A glance at the results of our seedling experiments (Tables 3 and 4) shows that, with slight exceptions due to experimental errors, the soils heated to temperatures in the vicinity of 120° to 170° C. contain substances soluble in water which exert a strong inhibitory effect upon lupin seedlings grown in such solutions. The results of our oat culture work are in harmony with the idea, which Lyon also held, that strong heating produces soluble material harmful to green plants. The fact that extracts used for the seedling studies, and the extracts from the oat culture soils, were analyzed and found to have quantitative relations depending on the intensity of the heat, seems to indicate that the causes are to be found in *chemical* changes rather than changes in the soil flora, and so on.

SUMMARY OF CONCLUSIONS

1. The color of the extracts of heated soils varies with the temperatures to which the soils have been subjected; the extract of unheated soil being colorless, that of soil heated at 90° C. being slightly yellowish, that of soil heated at 120° C. being more deeply colored.

2. The amount of soluble matter in the soil also varies with the temperature to which the soil has been exposed and to this the color of the extracts serves as an index; the deeper the color the more soluble matter the extracts contain.

3. The length of time during which the soil has been exposed seems to be of little moment; soil heated at 120° C. for ten hours containing little more soluble matter than the same soil heated at the same temperature for only two hours.

4. Growth of the *green plants* used by us is slightly accelerated in soils heated at low temperatures (90–120° C.) but above this point growth is retarded, the retardation increasing with the temperature to which the soils have been exposed.

5. Retardation seems not to be due to the toxic effects of the substances rendered soluble, but to the fact that they are present in such large quantities that the plant is unable to absorb them.

6. The influence of heated soils on the growth of *fungi* is the opposite of that on the growth of green plants, the growth becoming more luxuriant as the temperature is increased. This can be explained by the fact that fungi, unlike most green plants, have the power of adapting themselves to nutrient media of a comparatively high degree of concentration.

7. The beneficial or harmful results, therefore, of the heating of a soil for the growth of plants, depends upon the temperature to which the soil has been heated as well as upon the nature of the soil and the plant.

8. The preference of certain plants for burned-over areas or for peaty soils may be explained by the acidity of such situations, a supposition we are testing by blueberry culture experiments now under way.

Finally, we wish to express our thanks to Professor William J. Gies for his helpful suggestions during the course of our investigations.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN — No. 155

POLYCODIUM

By C. B. ROBINSON

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Polycodium

C. B. ROBINSON

The statements by which Professor E. L. Greene* suggested the resuscitation of Rafinesque's name require quotation in full, as they bring up many points open to controversy.

"We have in the Eastern and Southern United States two groups of vacciniaceous shrubs either of which is at variance with all genuine *Vaccinium* in two important points of floral structure. The corollas in both groups are campanulate, while in both *Vaccinium* and *Gaylussacia* they are urceolate. The stamens also, in these campanulate-flowered shrubs, are of a structure so peculiar that, on the characters of this organ alone, a genus might reasonably be established, were concomitant characters wanting. *Vaccinium* and *Gaylussacia* are now everywhere admitted as distinct, yet, exclusive of the groups here under special notice, there is not the slightest difference of floral structure between the two. But these other shrubs depart widely from the characters of both *Vaccinium* and *Gaylussacia* not only in their open-campanulate corollas, but in respect to their stamens, which organs are doubly marked by extremely long and slender anther-tubes, and two prominent horn-like projections on the back; so that nothing approaching these characters is found in any other genera allied to *Vaccinium*.

"Twice in the early part of the century, botanists of first-class ability proposed the separation of these species from *Vaccinium*. Rafinesque in 1818, not distinguishing generic differences between those types represented by *V. stamineum* and *V. arboreum* respectively—perhaps not even knowing *V. arboreum*—proposed the *V. stamineum* group for a genus under the beautifully appropriate name of POLYCODIUM; and Nuttall in 1843, ignoring Rafinesque's earlier proposition—just as later pretenders to taxonomic autocracy suppressed Nuttall's work—sought to establish a new genus *Batodendron* with *V. arboreum* as typical, and *Picrococcus* with *V. stamineum* for its type.

"The characters of the two genera are well indicated by Nuttall, in the transactions of the American Philosophical Society, with the exception of one new and most significant peculiarity of the *V. stamineum* group which I alone seem to have observed.

* Pittonia 3: 323. 1898.

It is this, that in this group the corollas are *open in the bud!* For from ten days to two weeks before the actual flowering, and even from the time that the buds are green and scarcely larger than a pin-head, the corolla is open and campanulate. This is another character otherwise unknown in the family of plants to which these belong. Certainly in *Vaccinium* and *Gaylussacia* the buds are tightly closed, in an imbricate aestivation, until the corollas are full-grown and the anthers mature."

Now of vacciniaceous plants found within the limits of the United States, the genera that are almost universally recognized are *Chiogenes*, *Gaylussacia*, and *Vaccinium*. Even regarding these there is some controversy. *Chiogenes* is readily distinguished by the position of the ovary, only slightly inferior in flower, distinctly inferior in fruit, and while American and British authors of recent years have agreed in placing it near *Vaccinium*, German authors on the other hand believe the closest affinity to be *Gaultheria;* and it can hardly be denied that its position is somewhat intermediate,

There is no doubt as to the identity of *Gaylussacia*, as it was published as monotypic, its type, *G. buxifolia* H. B. K., agreeing with many species now known from South America, in the possession of evergreen leaves and non-succulent fruit as well as of a 10-celled ovary. The only species described as a *Gaylussacia* from Mexico or Central America does not belong to the genus, all of the species so called in the United States have succulent fruit, and all but one have deciduous leaves. Niedenzu* has placed that one in the Vitis-Idaea section of *Vaccinium*, and the other North American species in the Cyanococcus section of *Vaccinium*, retaining the name *Gaylussacia* for South American species only.

Kuntze,† also, has taken up the name *Adnaria* Raf.‡ for *Gaylussacia*, but the most positive thing that can be said about Robin's description,§ upon which Rafinesque's was based, is that it does not agree with that of any species of the family found in America and in particular disagrees with *Gaylussacia* in the very character relied on for its differentiation, the number of cells in the ovary.

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* Engl. Bot. Jahrb. 11: 193. 1889.

† Rev. Gen. Pl. 382. 1891.

‡ Fl. Ludov. 56. 1817.

§ Voy. Int. Louisiana 3: 422. 1807.

Yet, taken on a summary of characters, there is probably no species found in Louisiana that is more likely to have been the basis for Robin's description than *Gaylussacia dumosa* (Andr.) A. Gray.

All of the remaining species of the family found north of the Mexican border are retained by many authors in *Vaccinium.* Generic or sectional segregation has been proposed on several characters, taken singly or in combination, the degree of union of the corolla, its aestivation, its shape, the presence or absence of awns on the anthers, the presence or absence of pubescence on the filaments, the presence or absence of false partitions in the ovary, the nature of the inflorescence, and tetramerous as contrasted with pentamerous flowers.

In the Thibaudieae, the other subfamily of Vacciniaceae, general agreement has been reached that the primary basis of differentiation should be sought in the stamens. There is much reason to believe that this is equally true with regard to the *Vaccinium* group, but it would be useless to belittle the fact that the weight of botanical opinion has been otherwise. The most popular segregate has been *Oxycoccus,* from which *Hugeria* has further been discriminated. They differ from the remainder of the group and from one another in the degree of division of the corolla. Possibly *Polycodium* will prove the most acceptable of the others. But on what grounds should it be retained? Professor Greene's claims for it are excessive, although indefinite, for he does not define "genuine *Vaccinium.*" It has a campanulate corolla: so have *V. arboreum* Marsh.,* *V. Vitis-Idaea* L., *V. poasanum* Donn. Sm., *V. confertum* H. B. K., and others, differing from one another in various characters, and none except the first closely allied to *Polycodium.* The 10 stamens of *Polycodium* have pubescent filaments and 2-awned anthers: except in number they differ from the great majority of species of the eastern and southern United States, which have pubescent filaments but awnless anthers (section Cyanococcus), from most of those of the western States, which have 2-awned anthers but glabrous filaments (section Euvaccinium), but agree with many tropical American species,

* No opinion is necessarily expressed in giving the name of this or any other species as *Vaccinium.*

such as *V. leucanthum* Schlecht., *V. stenophyllum* Steud., and *V. cubense* Griseb., none at all closely allied to *Polycodium*. This is not all, for in the United States no single character is as certain to ensure the instant identification of *Polycodium* as the long-exserted anthers; moreover, the tubes forming the prolongation of the anther cells are unusually long, both absolutely and relatively to the anther cells. But there is a Mexican species, *Vaccinium Kunthianum* Klotzsch, so closely related to *Polycodium stamineum* that neither Kunth nor Dunal* thought it worthy of specific rank. Its stamens were described as half-exserted, and figured as well exserted, but in no collection that I have seen, so identified by others or by myself, can they be considered as more than barely exserted, the anthers are shorter than in the other species, and the anther tubes only about one and a half times the length of the anther cells. In all other respects it is a perfectly good *Polycodium*, and if the genus is to be maintained, must be transferred to it, forming a section by itself, on the basis of the characters just stated.

Finally, the anther awns are often revolute, but too much emphasis should not be placed on this, as it is not always constant within a single flower; at least, however, they are divaricate, but so they are in species which no one has suggested separating from *Vaccinium*, such as *V. caespitosum* Michx.

The flowers of *Polycodium* are articulated with the pedicel; this is also true of certain species placed in *Vaccinium* by most authors, notably of the *Disterigma* species. That group, which does not come north of Mexico, was until recently treated by all authors as a section of *Vaccinium*, but Niedenzu† and Hörold‡ so far separate it from that genus that they place it in the Thibaudieae. On the basis of floral characters there seems to be no reason for so wide separation; indeed, unless *Vaccinium* is to be radically divided, I at least believe that there is as much reason for placing *V. Myrtillus* L. and its American allies in a different genus from *V. corymbosum* L. and its allies, as there is for so segregating *Disterigma* from the latter. Drude§ has placed considerable

* H. B. K. Nov. Gen. & Sp. **3**: 267. *pl. 253*. 1819; DC. Prodr. **7**: 568. 1839.

† Engl. Bot. Jahrb. **11**: 209. 1889.

‡ Engl. Bot. Jahrb. **42**: 282. 1909.

§ Engler & Prantl, Die Nat. Pflanzenfam. 4[1]: 32. 1889.

emphasis on articulated pedicels as a means of distinguishing the Thibaudieae from the Vaccinieae but, unfortunately, has gone far beyond the facts.

One character remains to which Professor Greene has called particular attention, the open aestivation of the corolla. All evidence that has been obtained confirms his statement on this point for every species of *Polycodium*, including *V. Kunthianum*. This does seem of such importance that the genus may properly be maintained; the other characters previously mentioned may be treated as collateral, by one who is dealing with the species of America north of Mexico, but it must be remembered that not one of them can be relied on to distinguish *Polycodium* from all other genera, even within the limits of North America.

Rafinesque* published *Polycodium* thus: "67. The species of *Vaccinium* with campanulated corollas, must form a peculiar genus or subgenus, *Polycodium*. In fact the whole tribe of *Ericacea* or *Bicornia* must be newly modelled." And this is all, with one very important exception. The paragraph occurs in a review of Pursh's Flora Americae Septentrionalis and may fairly be interpreted by reference to that work. Pursh divided *Vaccinium*† primarily into species with deciduous leaves and those with evergreen leaves, dividing each of these in turn on the basis of campanulate as contrasted with urceolate corollas. His species with deciduous leaves and campanulate corollas were *V. stamineum*, *V. album*, *V. arboreum*, *V. dumosum*, *V. frondosum*, and *V. pallidum;* those with persistent leaves and campanulate corollas were *V. Vitis-Idaea*, *V. myrtifolium*, and *V. crassifolium*. *Vaccinium stamineum* thus comes first, and *V. album* Pursh is regarded by most authors as the same species. *Polycodium*, therefore, may be held to be typified by *Vaccinium stamineum* L., but Rafinesque's genus in its entirety was a mixture of widely differing elements, including representatives not only of *Batodendron* but of *Gaylussacia* and of different sections still included in *Vaccinium* by nearly all authors.

Picrococcus of Nuttall is based almost entirely on *Vaccinium stamineum* L. (including *V. elevatum* Banks & Soland.) with the

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* Am. Monthly Mag. 2: 266. 1818.

† Fl. Am. Sept. 1: 284–290. 1814.

addition of a second species, *Picrococcus floridanus*, certainly congeneric with the former, of which more hereafter.

Professor Greene is unduly critical of Nuttall for overlooking or disregarding such a publication as Rafinesque's of *Polycodium* for the genus containing *Vaccinium stamineum*, and Nuttall was not the first offender. In 1836 Rafinesque himself has the following:* "ADNARIA Raf. fl. lud. probably a subgenus of the *Codorolla* or Vacciniums with bell flowers, which see." But *Codorolla* does not appear again, and Rafinesque did not consider this reference worth indexing.

It is apparent that the adoption of *Polycodium* as a generic name, to be typified by *Vaccinium stamineum* L., is barely justified.

Before leaving the subject of generic subdivision in the *Vaccinium* alliance it is desired to amplify a statement above made with regard to the importance of characters derived from the stamens. The anthers may be 2-awned or awnless. In a solitary specimen, *Wright 2202*, referred to *Vaccinium Ramonii* Griseb., some anthers were found with a single central awn. Further examination showed that this was not a constant character, even within a single flower; but none of the anthers were awnless. The value of anther awns as a diagnostic character obviously depends upon the degree of their constancy, and final judgment will be influenced, consciously or unconsciously, by the nature of the grouping thus achieved.

Examination of the flowers of every species but one, found within the limits of North America, as well as of some extralimital material, gives this result. There are 3, or more likely only 2, species, *V. meridionale* Sw., of Jamaica, *V. consanguineum* Klotzsch, of Panama and Costa Rica, and *V. multiflorum* Benth., of Colombia, in which this character has to be handled with extreme caution. All of these are very closely allied; indeed, it is doubtful if the first two can be held distinct. In all of these the awns are very delicate and often closely appressed, to such an extent that they might escape detection, unless considerable care be taken in their search. Further, in *V. meridionale* they are often so reduced that they are practically wanting, yet other stamens in the same flower may possess them, slender and short

* New Fl. 1: 65. 1836.

indeed, but certainly present. Moreover, *V. multiflorum* was described as having anthers alternately awned and awnless, yet a recent collection from near its type locality, *Pittier 1182*, agreeing otherwise with Bentham's description, has all the anthers of such flowers as were examined 2-awned, with awns as described and found for this and for *V. consanguineum*. The plate* of *V. meridionale* is wrong in this respect.

Yet, all these can be described as awned anthers, and on other grounds the alliance of the species is with those possessing awned anthers. Much search has failed to disclose a single other exception, not only within the limits of a species but within the limits of what appear to be groups of related species.

It may be added that the presence of pubescence, in whatever degree, on the filaments or the connectives—and when it occurs it is usually on both—is equally conclusive but of secondary importance. Thus, if a vacciniaceous plant be found in America north of Mexico with awnless anthers and glabrous filaments, no further information is needed for its determination as *Gaylussacia frondosa* (L.) T. & G., except by those who consider *G. nana* (A. Gray) Small and *G. tomentosa* (Pursh) Chapm. to be specifically distinct from that species. Each of the other three combinations of these two characters will describe large groups of species.

On the other hand, investigation of the relative length and degree of divergence of the awns and of the relative amount of pubescence on the filaments seems to indicate that these do not afford reliable characters except possibly in rare cases.

Up to the present the following have been ascribed to *Polycodium* as distinct species: *P. caesium* Greene, *P. candicans* (C. Mohr) Small, *P. elevatum* (Banks) Greene, *P. floridanum* (Nutt.) Greene, *P. Langloisii* Greene, *P. melanocarpum* (C. Mohr) Small, *P. neglectum* Small, *P. oblongum* Greene, *P. oliganthum* Greene, *P. revolutum* Greene, and *P. stamineum* (L.) Greene; it has already been stated that another species awaits transfer, *Vaccinium Kunthianum* Klotzsch. The last having been separated on the basis of its shorter anthers, not or barely exserted, the character depended on as of next importance is the relation between leaves or bracts and the inflorescence.

* Sw. Ic. Ind. Occ. *pl. 12.* 1794.

In the *Vaccinium* group as a whole there is a transition in this respect, and *Polycodium* is merely one case of many. In certain species, such as *V. caespitosum* Michx., *V. scoparium* Rydb., and *V. Myrtillus* L., the flowers are few in number on a branch borne in the axils of what are apparently quite normal leaves as to size, shape, and texture. In others the inflorescence is quite clearly racemose, or by contraction fasciculate, the pedicels subtended by bracteoles quite different in appearance from the vegetative leaves. This includes nearly all the species of the eastern United States. There is yet a third group, which almost perfectly links the two, the inflorescence being perhaps best described as a leafy raceme. These are mostly tropical plants. Incidentally, these three groups follow rather closely the lines indicated by the stamens.

In the case of *Polycodium* there is a group "in which," to use Nuttall's expression* when describing *Picrococcus floridanus*, "the flowers appear truly axillar." Here also belong the names *Polycodium caesium* Greene, *P. oliganthum* Greene, and *P. revolutum* Greene. Nuttall's type seems to have perished, which will cause trouble to those who believe this group to contain more than one species, for he has no sufficient description for more definite determination. In the case of the other species duplicates of the type collections have been examined, and there seems no sufficient reason for holding them distinct. In separating *P. revolutum* from *P. caesium* Professor Greene† relies chiefly on the leaves of the former being more pubescent, more oval and obtuse, their margins revolute, the calyx lobes deeper, acute or acuminate instead of scarcely acute, and deeper corolla lobes. It is not possible to separate the series of specimens on these characters or any of them, those drawn from the leaves being especially unreliable, not even holding for the collections on which the species were based. There seems even less reason for segregating *P. oliganthum*.

Now, the same thing happens in *Polycodium* as in the *Vaccinium* group in general; the leaves, in the axils of which the flowers are borne, are often reduced in size but still retain the other characters of the typical leaves of the plant; yet again, they may

* Trans. Am. Philos. Soc. II. **8**: 262. 1843.

† Pittonia **3**: 249, 250. 1897.

be very greatly reduced although sometimes differing considerably within the same inflorescence. *P. oliganthum* approaches the former condition but seems to have been referred correctly to the *P. floridanum* group. The linking material affords some justification for the view that specific lines should not be drawn on this character, but the corolla in the group thus separated is always smaller, one half to one third of the length of that of the remaining species, and it seems preferable to consider it as distinct and as forming a single species only. Its range is from South Carolina to Florida, all of the types of the species proposed having come from the latter state. If this view be accepted, there seems no reason why its name should not be *Polycodium floridanum* (Nutt.) Greene.

From the remainder it is exceedingly easy to separate *Polycodium neglectum* Small by means of its glabrous branchlets and leaves. These characters hold definitely for large series of collections, but there seem no others correlated with them, and the plants often grow side by side with those of *P. stamineum*. It is, therefore, a matter of opinion as to whether the two should be held distinct.

Polycodium melanocarpum was described by Mohr* as *Vaccinium stamineum melanocarpum* without a definite type specified. It was raised to specific rank by Kearney,† who expressly stated that his own collections were not typical. Mohr,‡ subsequently discussing it as a species, gives as the type locality "Mountain region of Alabama. More specifically, St. Clair County, near Ashville, July 1880." The ground for separation was the succulent nature of the fruit and its color. Mohr also proposed two varieties, *V. melanocarpum candicans* and *V. melanocarpum sericeum*. In Small's Flora§ the former variety becomes *P. candicans* (C. Mohr) Small, and *Polycodium melanocarpum* includes both the species and its variety *sericeum;* "hypanthium *usually* more or less pubescent." The seventh edition of Gray's Manual goes further: "calyx white-tomentose." Study of material in the herbarium of

* Bull. Torrey Club **24**: 25. 1897.

† Bull. Torrey Club **24**: 570. 1897.

‡ Contr. U. S. Nat. Herb. **6**: 658. 1901.

§ Fl. SE. U. S. 894. 1903.

the New York Botanical Garden led to the conviction that *Vaccinium melanocarpum* of Gray's Manual is a good species, but that it is not identical with Mohr's species but with his variety *sericeum* only. On all sheets in the New York herbarium the character of pubescence on the hypanthium, always more or less definitely present on fruit as well, was accompanied by another character. The calyx lobes were accrescent in late flower or early fruit. This was easily evident to the eye, but on measuring, the balance of difference proved slight, the fruiting calyx being 1.5–2 mm. long in *P. stamineum* and 2.5–3 mm. long in the collections referable to *sericeum*. There was a single plant in which a glabrous hypanthium was accompanied by an accrescent calyx. This plant, on fine division, would be referred to *P. candicans* Small.

Examination of material from the United States National Herbarium shows that the same is true of the collections there. But the specimen that Mohr seems to have considered as the type of his species has a glabrous hypanthium, and the calyx is not accrescent. So far, then, as *Polycodium melanocarpum* (C. Mohr) Small is concerned, there is room for difference of opinion; if the character of succulent fruit is considered sufficient, it may be maintained as a species, but no other sufficient reason has been found for holding it specifically distinct from *P. stamineum*. But the evidence is otherwise as regards *V. melanocarpum sericeum*.

Typical forms of *P. candicans* (C. Mohr) Small differ notably from more typical *P. stamineum* in glaucescence, but the extremes are united by many intermediates, and no sharp line for separation has been found. Moreover, there is much reason for believing that this is a revival of *P. elevatum* Greene, the *Vaccinium album* of Pursh, although not the Linnaean species of the latter name, which does not belong to the family.

Two species have not been discussed, *P. oblongum* Greene and *P. Langloisii* Greene, of neither of which I have seen the types. Its author places the former in the *P. floridanum* group, but from the description and study of material which seems to match it I am inclined to refer it to *P. stamineum*, to which also *P. Langloisii* seems too closely related.

The following new combinations give effect to conclusions already stated.

Polycodium Kunthianum (Klotzsch) comb. nov.

Vaccinium stamineum β H. B. K. Nov. Gen. & Sp. **3**: 267. 1819.
Vaccinium elevatum β Dunal, in DC. Prodr. **7**: 568. 1839.
Picrococcus elevatus β Nutt. Trans. Am. Philos. Soc. II. **8**: 262. 1843.
Vaccinium Kunthianum Klotzsch, Linnaea **24**: 56. 1851.

Polycodium sericeum (C. Mohr) comb. nov.

Vaccinium melanocarpum sericeum C. Mohr, Contr. U. S. Nat. Herb. **6**: 658. 1901.
Vaccinium melanocarpum Robinson & Fernald, in Gray, Man. ed. 7. 639. 1908. Not *V. melanocarpum* C. Mohr, 1897.

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By PER AXEL RYDBERG

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Studies on the Rocky Mountain flora—XXVIII

PER AXEL RYDBERG

FABACEAE

Thermopsis ovata (Robinson) Rydb.

Thermopsis montana ovata Robinson, Contr. U. S. Nat. Herb. **11**: 349. 1906.

This differs from *T. montana* not only in its broader leaflets (the only characters given in the original description) but in its spreading leaves, its large stipules, which in the lower leaves are ovate and very oblique, and in its elongate and lax raceme. It differs from *T. xylorrhiza* A. Nels. in its lax inflorescence and strictly straight pods.

Dr. S. Watson in publishing *Lupinus Kingii* described the plant as being perennial. This mistake of his led him as well as others astray, for he redescribed the same plant a few years later as an annual under the name *L. Sileri*. This fact has been called attention to several times and, among other places, in my Flora of Colorado. It is, therefore, surprising that the error should be repeated by Coulter and Nelson in the New Manual of Botany of the Central Rocky Mountains, where the description begins: "From a perennial rootstock, dwarf, cespitose," etc., characters which in no way apply to the type in the Gray Herbarium nor to the duplicates in the herbaria of Columbia University and the United States National Museum. Furthermore, Coulter and

Nelson give as a synonym under the same *Lupinus aduncus* Greene, which is the same as *L. argenteus argophyllus*, a plant of different habit.

The so-called *Lupinus rivularis* of the Columbia region and extending into Idaho should be known as *L. cytisoides* Agardh. Miss Alice Eastwood has seen the type of *L. rivularis* Dougl., which according to her belongs to an entirely different group from the plant called *L. rivularis* by Dr. Watson in his revision.

The following Lupines are to be added to the flora of the Rocky Mountains: *Lupinus nootkatensis* Donn has been collected in the Rockies of British Columbia and Alberta, *L. plumosus* Dougl. in Idaho and Utah, *L. minimus* Dougl. in Idaho and Alberta, *L. lepidus* Dougl. in Idaho, *L. Cusickii* S. Wats. in Idaho and Utah, and *L. micensis* Jones in Utah.

Lupinus lupinus Rydb. sp. nov.

Perennial with a woody caudex; stems 3–6 dm. high, densely strigose-canescent, sparingly branched; leaves numerous; stipules subulate, about 1 cm. long; petioles canescent, 5–8 cm. long; leaflets 7–9, oblanceolate, usually flat, 3–6 cm. long, appressed-canescent on both sides, less so above; peduncles about 1 dm. long; raceme 5–10 cm. long; bracts lanceolate, acute, 3–4 mm. long, silvery-pubescent, early deciduous; calyx silvery-pubescent, saccate at the base; upper lip scarcely 3 mm. long, the lower fully 5 mm.; corolla about 1 cm. long, dark blue or purple; banner orbicular, pubescent on the back, usually with a light spot in the center; keel strongly curved, rather broad, ciliate on the margins; pod densely villous, about 3 cm. long, mostly 3-seeded.

This is related to *L. argentinus*, *L. aduncus*, and *L. oreophilus*, but differs from the first in its grayish instead of silvery pubescence of the leaves, which are greener above and not conduplicate, and in its less spurred calyx; from *L. aduncus* in its broader leaves and the shorter upper lip of its calyx; and from *L. oreophilus* in its broader leaves and saccate calyx.

Along streams and in meadows at an altitude of 2,000–3,000 m.

UTAH: Western Bear's Ear, Elk Mountains, Aug. 2, 1911, *Rydberg & Garrett 9363* (type, in herb. N. Y. Bot. Gard.); also western slope of La Sal Mountains, July 6, *8595*, *8596*, and *8600;* meadow south of Monticello, July 24, *9167;* Head of Dry Wash, Abajo Mountains, August 11, *9605;* Hammond Canyon, Elk Mountains, August 10, *9583*.

LOTUS TENUIS Waldst. & Kit.; Willd. Enum. Hort. Berol. 797. 1809

Lotus tenuifolius (L.) Reich. Fl. Germ. 506. 1830.
Lotus Macbridei A. Nels. Bot. Gaz. **53**: 221. 1912.

In looking over a collection received in exchange from the University of Wyoming, I found a specimen labeled *Lotus Macbridei* A. Nels. n. sp. To my surprise I found that this was a true *Lotus*, i. e. not belonging to any of the segregates of *Hosackia* but of the European type. As it would have been exceedingly strange if a species of *Lotus* in the restricted sense should be found native in America, I turned to our collection of Old World species of *Lotus* and found that it is the same as *L. tenuifolius* (L.) Reich. Before I had time to call Professor Nelson's attention to the fact, his description appeared in the Botanical Gazette.

Trifolium macrocephalum (Pursh) Piper, *T. plumosum* Dougl., *T. eriocephalum* Nutt., *T. spinulosum* Dougl., and *cyathiferum* Lindl. have been collected in Idaho; *T. Rusbyi* Greene and *Medicago hispida* Gaertner (*M. denticulata* Willd.) in Montana.

ACMISPON Raf. New Flora **1**: 53. 1836

I think that this genus should be restored. The *Microlotus* section sometimes referred to *Hosackia*, sometimes to *Lotus*, is out of place in either genus, and *Acmispon* is the oldest available generic name.

Acmispon americanus (Nutt.) Rydb.

Lotus sericeus Pursh, Fl. Am. Sept. 489. 1814. Not *L. sericeus* DC. 1813.
Trigonella americana Nutt. Gen. **2**: 120. 1818.
Hosackia Purshiana Benth. Bot. Reg. under *pl. 1257*. 1829.
Acmispon sericeum Raf. New Fl. **1**: 53. 1836.
Lotus americanus Bisch. Del. Sem. Hort. Heidelb. 1839.
Trigonella sericea Eat. & Wright, N. Am. Bot. Ed. 8, 459. 1840.

Acmispon elatus (Nutt.) Rydb.

Hosackia elata Nutt.; T. & G. Fl. 1: 327. 1838.

The former of the two species is common on the plains from Minnesota to Arkansas, Sonora, and Idaho; the latter is found in Washington, Oregon, and Idaho. A few more species are found in California.

Psoralea stenostachys Rydb. sp. nov.

Perennial with a horizontal rootstock; stem adsurgent or erect, branched, sparingly strigose and glandular-dotted, 3–5 dm. high; leaves digitately 3-foliolate; leaflets oblanceolate, 2–4 cm. long, from rounded to acute at the base, mucronate at the apex, sparingly strigose and conspicuously glandular-punctate; peduncles 5–15 cm. long; racemes elongate, many-flowered and lax: calyx densely white-strigose; tube 1.5 mm. long; teeth 0.5 mm. long, lanceolate or lance-ovate, acute; corolla white, 4 mm. long; pod densely white-hairy.

This species is related to *P. lanceolata* Pursh and *P. Purshii* Vail, but differs from both in the elongate racemes and the acute calyx-lobes; from the former it differs also in the hairy pod, and from the latter in the narrower leaflets. It grows on sandy soil at an altitude of about 1,300–1,500 m.

UTAH: Government Well, Toole County, June 7, 1900, *M. E. Jones 6221* (type, in herb. N. Y. Bot. Gard.); Utah, July 2, 1888, *M. E. Jones 1833*.

Psoralea stenophylla Rydb. sp. nov.

Perennial with a horizontal rootstock; stem simple, about 5 dm. high, slender, sparingly strigose and glandular-punctate; leaves digitately 3-foliolate or the lower 5-foliolate; leaflets narrowly linear, 2.5–5 cm. long, about 2 mm. wide, glandular-punctate and sparingly strigose; stipules linear, 5–8 mm. long; petioles about 3 cm. long; peduncles 8–10 cm. long; racemes elongate, 5 cm. long or longer, lax; pedicels usually longer than the calyx; calyx sparingly strigose, conspicuously punctate; lobes triangular, acute, 0.5 mm. long; corolla about 4 mm. long; fruit not seen.

This has the narrow leaflets of *Psoralea micrantha*, but the raceme is elongate and the sepals are acute as in the preceding species, from which it differs in the very narrow leaflets. If it has the densely hairy pod of that species and *P. Purshii*, it cannot be told from the material, but the young ovaries do not indicate such a character. It grows on sandy river banks at an altitude of about 1,600 m.

UTAH: Proposed dam site, near Wilson Mesa, Grand County, July 1, 1911, *Rydberg & Garrett 8367* (type, in herb. N. Y. Bot. Gard.).

Psoralea juncea Eastw. was described as being leafless, the leaves being reduced to scales. This is true as far as the stem-leaves are concerned. The basal leaves, which soon wither away, are digitately 3–5-foliolate with lanceolate leaflets, 2–3 cm. long, grayish, strigose and strongly veiny.

Psoralea obtusiloba Torrey has been collected in Colorado by Tweedy.

Parosela polydenia (Torr.) Heller, *P. Fremontii* (Torr.) Vail, *P. Johnsoni* (S. Wats.) Vail, and *P. amoena* (S. Wats.) Vail have been collected in southern Utah.

Phaca ampullaria (S. Wats.) Rydb.

Astragalus ampullarius S. Wats. Am. Nat. **7**: 300. 1873.

Phaca Wardii (A. Gray) Rydb.

Astragalus Wardii A. Gray, Proc. Am. Acad. **12**: 55. 1877.

Phaca subcinerea (A. Gray) Rydb.

Astragalus subcinereus A. Gray, Proc. Am. Acad. **13**: 366. 1878.

Phaca Cusickii (A. Gray) Rydb.

Astragalus Cusickii A. Gray, Proc. Am. Acad. **13**: 370. 1878.

Phaca sabulonum (A. Gray) Rydb.

Astragalus sabulonum A. Gray, Proc. Am. Acad. **13**: 368. 1878.

Phaca Preussii (A. Gray) Rydb.

Astragalus Preussii A. Gray, Proc. Am. Acad. **6**: 222. 1864.

Phaca serpens (M. E. Jones) Rydb.

Astragalus serpens M. E. Jones, Proc. Cal. Acad. II. **5**: 641. 1895.

Phaca Silerana (M. E. Jones) Rydb.

Astragalus Sileranus M. E. Jones, Zoe **2**: 242. 1891.

Phaca jejuna (S. Wats.) Rydb.

Astragalus jejunus S. Wats. Bot. King Exped. 73. 1871.

Phaca leptalea (A. Gray) Rydb.

Phaca pauciflora Nutt.; T. & G. Fl. N. Am. **1**: 348, 1838. Not *P. pauciflora* Pers. 1806.
Astragalus leptaleus A. Gray, Proc. Am. Acad. **6**: 220. 1864.

Phaca artemisiarum (M. E. Jones) Rydb.

Astragalus Beckwithii purpureus M. E. Jones, Zoe **3**: 288. 1893. Not *A. purpureus* Lam. 1783.
Astragalus artemisiarum M. E. Jones, Zoe **4**: 369. 1894.

Phaca pubentissima (T. & G.) Rydb.

Astragalus multicaulis Nutt.; T. & G. Fl. N. Am. **1**: 335. 1838. Not *A. multicaulis* Ledeb. 1831.
Astragalus pubentissimus T. & G. Fl. N. Am. **1**: 693. 1840.

Mr. Sheldon placed this between *Astragalus crescenticarpus* and *A. cibarius*, two species of *Xylophacos;* its pod is that of a *Phaca.*

Phaca sesquiflora (S. Wats.) Rydb.

Astragalus sesquiflorus S. Wats. Proc. Am. Acad. **10**: 346. 1875.

Mr. Sheldon associated this erroneously with *Astragalus vexilliflexus* and other species of *Homalobus.* It is a true *Phaca.*

Xylophacos cuspidocarpus (Sheld.) Rydb.

Astragalus cuspidocarpus Sheld. Minn. Bot. Stud. **1**: 147. 1894.

Xylophacos cibarius (Sheld.) Rydb.

Astragalus cibarius Sheld. Minn. Bot. Stud. **1**: 149. 1894.
Astragalus arietinus M. E. Jones, Proc. Calif. Acad. II. **5**: 653. 1895.

Xylophacos puniceus (Osterh.) Rydb.

Astragalus puniceus Osterh. Muhlenbergia **1**: 140. 1906.

Xylophacos Zionis (M. E. Jones) Rydb.

Astragalus Zionis M. E. Jones, Proc. Calif. Acad. II. **5**: 652. 1895.

Xylophacos argophyllus (Nutt.) Rydb.

Astragalus argophyllus Nutt.; T. & G. Fl. N. Am. **1**: 331. 1838.

Xylophacos cymboides (M. E. Jones) Rydb.

Astragalus cymboides M. E. Jones, Proc. Calif. Acad. II. **5**: 650. 1895.

Xylophacos musinensis (M. E. Jones) Rydb.

Astragalus musinensis M. E. Jones, Proc. Calif. Acad. II. **5**: 671. 1895.

Xylophacos consectus (Sheld.) Rydb.

Astragalus consectus Sheld. Minn. Bot. Stud. **1**: 143. 1894.

Xylophacos Watsonianus (Kuntze) Rydb.

Astragalus eriocarpus S. Wats. Bot. King Exped. 71. 1871. Not *A. eriocarpus* DC. 1802.
Tragacantha Watsoniana Kuntze, Rev. Gen. Pl. **2**: 942. 1891.
Astragalus Watsonianus Sheld. Minn. Bot. Stud. **1**: 144. 1894.

Xylophacos utahensis (Torr.) Rydb.

Phaca mollissima utahensis Torr. Stansb. Exped. 385. 1852.
Astragalus utahensis T. & G. Pac. R. Rep. **2**: 120. 1855.

Xylophacos inflexus (Dougl.) Rydb.

Astragalus inflexus Dougl. in G. Don, Gen. Syst. **2**: 256. 1832.

Tium eremiticum (Sheld.) Rydb.

Astragalus eremiticus Sheld. Minn. Bot. Stud. **1**: 161. 1894.

Tium atropubescens (Coult. & Fish.) Rydb.

Astragalus atropubescens Coult. & Fish. Bot. Gaz. **18**: 300. 1893.
Astragalus Kelseyi Rydb. Mem. N. Y. Bot. Gard. **1**: 241. 1900.

Tium arrectum (A. Gray.) Rydb.

Astragalus arrectus A. Gray, Proc. Am. Acad. **8**: 289. 1873.
Astragalus Leibergii M. E. Jones, Proc. Calif. Acad. II. **5**: 663. 1895.
Astragalus palousiensis Piper, Bot. Gaz. **22**: 489. 1896.

Hamosa calycosa (Torr.) Rydb.

Astragalus calycosus Torr. in S. Wats. Bot. King Exped. 66. 1871.

Ctenophyllum Grayi (Parry) Rydb.

Astragalus Grayi Parry; Wats. Am. Nat. **8**: 212. 1874.

Cystium platytropis (A. Gray) Rydb.

Astragalus platytropis A. Gray, Proc. Am. Acad. **6**: 526. 1865.

Cystium Coulteri (Benth.) Rydb.

Astragalus Coulteri Benth. Pl. Hartw. 307. 1848.

Cystium ineptum (A. Gray) Rydb.

Astragalus ineptus A. Gray, Proc. Am. Acad. **6**: 525. 1865.

Cystium lentiginosum (Dougl.) Rydb.

Astragalus lentiginosus Dougl.; Hook. Fl. Bor.-Am. **1**: 151. 1831.

Cystium araneosum (Sheld.) Rydb.

Astragalus araneosus Sheld. Minn. Bot. Stud. **1**: 170. 1894.

Cystium boiseanum (A. Nels.) Rydb.

Astragalus boiseanus A. Nels. Bot. Gaz. **53**: 223. 1912.

Atelophragma lineare Rydb. sp. nov.

Homalobus aboriginum Rydb. Bull. N. Y. Bot. Gard. **2**: 176, in part. 1901.

Perennial with a woody taproot and short cespitose caudex; stem grayish strigose, often tinged with purple, 2–4 dm. high; stipules ovate or lanceolate, acute, 2–4 mm. long; leaves 5–6 cm. long; leaflets 9–15, linear, 1–2 cm. long, 1–2 mm. wide, grayish strigose; peduncles 5–10 cm. long; raceme 2–3 cm. long, in fruit 6 cm. long; calyx densely black-hairy; tube 3 mm. long; teeth subulate, 2 mm. long; corolla about 8 mm. long, ochroleucous or tinged with purple; keel tipped with dark purple; legume glabrous, stipitate; stipe 4–5 mm. long; body 25–28 mm. long, convexly curved on both sutures, but much more strongly so on the upper; the partial partition very narrow.

This is related to *A. glabriusculum* (A. Gray) Rydb. and *A. aboriginum* (Richardson) Rydb., but differs from the former in the grayish pubescence of the leaves, which are strigose instead of villous, and from both in the form of the pod. In both the lower suture of the pod is straight or slightly concavely curved.

YUKON TERRITORY: Foot of Lake Lebarge, 1899, *J. B. Tarleton 34b* (type, in herb. N. Y. Bot. Gard.); Dry Gulch, 1899, *Gorman 1014*.

ALBERTA: Rocky Mountains, 1857–1859, *Bourgeau*.

Atelophragma Forwoodii (S. Wats.) Rydb.

Astragalus Forwoodii S. Wats. Proc. Am. Acad. **25**: 129. 1890.

Sheldon places this species in the *Homalobus*, but it is closely related to *Atelophragma aboriginum* and *A. glabriusculum*.

Atelophragma glabriusculum (Hook.) Rydb.

Phaca glabriuscula Hook. Fl. Bor.-Am. **1**: 144. 1831.

Atelophragma ibapense (M. E. Jones) Rydb.

Astragalus ibapense M. E. Jones, Zoe **3**: 290. 1893.

Atelophragma Arthuri (M. E. Jones) Rydb.

Astragalus Arthuri M. E. Jones, Cont. West. Bot. **8**: 20. 1898.

Onix Mulfordae (M. E. Jones) Rydb.

Astragalus Mulfordae M. E. Jones, Cont. West. Bot. **8**: 18. 1898.

This species is the only representative in America of a group of plants segregated from *Astragalus* by Medicus. The other representatives are Asiatic. *Onix* is related to *Cystium* in having a membranous inflated 2-celled pod, but the pod is triangular in cross-section, the upper suture being acute and the lower more or less sulcate.

Microphacos parviflorus (Pursh) Rydb.

Dalea parviflora Pursh, Fl. Am. Sept. 474. 1814.
Astragalus gracilis Nutt. Gen. **2**: 100. 1818.
Phaca parviflora Nutt.; T. & G. Fl. N. Am. **1**: 348. 1838.

Diholcos scobinatulus (Sheld.) Rydb.

Astragalus Haydenianus major M. E. Jones, Zoe **2**: 241. 1891.
Astragalus Haydenianus nevadensis M. E. Jones, Zoe **2**: 241. 1891.
Astragalus scobinatulus Sheld. Minn. Bot. Stud. **1**: 24. 1894.

Phacopsis scaphoides (M. E. Jones) Rydb.

Astragalus arrectus scaphoides M. E. Jones, Proc. Calif. Acad. II. 5: 664. 1895.

Cnemidophacos confertiflorus (A. Gray) Rydb.

Astragalus confertiflorus A. Gray, Proc. Am. Acad. **13**: 368. 1878.

Cnemidophacos argillosus (M. E. Jones) Rydb.

Astragalus argillosus M. E. Jones, Zoe **2**: 241. 1891.

Cnemidophacos reventoides (M. E. Jones) Rydb.

Astragalus reventoides Jones, Proc. Calif. Acad. II. **5**: 661. 1895.

Cnemidophacos reventus (A. Gray) Rydb.

Astragalus reventus A. Gray, Proc. Am. Acad. **15**: 46. 1880.

Kentrophyta tegetaria (S. Wats.) Rydb.

Astragalus tegetarius S. Wats. Bot. King Exped. 76. 1871.

Homalobus lingulatus (Sheld.) Rydb.

Astragalus lingulatus Sheld. Minn. Bot. Stud. **1**: 118. 1894.

Homalobus exilifolius (A. Nels.) Rydb.

Astragalus exilifolius A. Nels. Bull. Torrey Club **26**: 10. 1899.

Homalobus simplicifolius (Nutt.) Rydb.

Phaca simplicifolia Nutt.; T. & G. Fl. N. Am. **1**: 350. 1838.
Astragalus simplicifolius A. Gray, Proc. Am. Acad. **6**: 231. 1864.

Homalobus lancearius (A. Gray) Rydb.

Astragalus lancearius A. Gray, Proc. Am. Acad. **13**: 370. 1878.

Homalobus miser (Dougl.) Rydb.

Astragalus miser Dougl.; Hook. Fl. Bor.-Am. **1**: 153. 1831.

Homalobus Dodgeanus (M. E. Jones) Rydb.

Astragalus Dodgeanus M. E. Jones, Zoe **3**: 289. 1893.

Mr. Sheldon placed this next to *Astragalus glabriusculus* (Hook.) Gray, but its pod has not a trace of a partition and the plant is a true *Homalobus*, not an *Atelophragma*.

Homalobus debilis (Nutt.) Rydb.

Phaca debilis Nutt.; T. & G. Fl. N. Am. **1**: 345. 1838.
Astragalus debilis A. Gray, Proc. Acad. Sci. Phila. 1863: 60. 1864.

Homalobus strigosus (Coult. & Fish.) Rydb.

Astragalus strigosus Coult. & Fish. Bot. Gaz. **18**: 299. 1893.
Astragalus griseopubescens Sheld. Minn. Bot. Stud. **1**: 24. 1894.

Homalobus episcopus (S. Wats.) Rydb.

Astragalus episcopus S. Wats. Proc. Am. Acad. **10**: 346. 1875.

Homalobus collinus (Dougl.) Rydb.

Phaca collina Dougl.; Hook. Fl. Bor.-Am. **1**: 141. 1831.
Astragalus collina Dougl.; G. Don, Gen. Syst. **2**: 256. 1832.

Aragallus Bigelovii (A. Gray) Rydb.

Oxytropis Lambertii Torr. Pac. R. Rep. **4**: 80. 1857. Not *O. Lambertii* Pursh. 1814.
Oxytropis Lambertii Bigelovii A. Gray, Proc. Am. Acad. **20**: 7. 1885.

Aragallus plattensis (Nutt.) Rydb.

Oxytropis plattensis Nutt.; T. & G. Fl. N. Am. **1**: 340. 1838.

Lathyrus graminifolius White and *L. Torreyi* A. Gray have been collected in southern Utah; *L. Nuttallii* S. Wats. and *L. obovatus* White in Idaho.

EUPHORBIACEAE

Chamaesyce Parryi (Engelm.) Rydb.

Euphorbia Parryi Engelm. Am. Nat. **9**: 350. 1875.
This has been collected in southern Utah.

Chamaesyce exstipulata (Engelm.) Rydb.

Euphorbia exstipulata Engelm. Bot. Mex. Bound. Surv. 189. 1859.
Euphorbia Aliceae A. Nels. Bot. Gaz. **42**: 50. 1906.
This has been collected as far north as Wyoming.

ACERACEAE

NEGUNDO (Ray) Ludwig-Boehmer, Def. Pl. 508. 1760

Professor Nieuwland in the American Midland Naturalist* discussed the North American species of box-elder. He used the name *Rulac*, believing in a pre-Linnaean priority for genera. As both the Vienna Rules and the American Code have adopted 1753 as the starting point for botanical nomenclature, few will follow him in the names adopted. If our box-elders are regarded as generically distinct from the maples, we must use the name *Negundo*. Professor Nieuwland recognizes six species. I think there should be recognized eight species in North America. The Texan form, *Rulac californica texana* Pax, is well distinct from *Negundo californicum*, Professor Nieuwland having overlooked the difference in the fruit, which in the Texan species agrees more with our eastern box-elder and was included in it by Dr. Britton. The following key was prepared by me over two years ago and two new species were named in manuscript. One of these has been described by Professor Nieuwland under the name *Rulac Nuttallii;* a description of the other is given below. I publish here the key, as several of the characters have not been pointed out by Professor Nieuwland.

Branches of the season glabrous or with a few scattered appressed hairs; anthers acute, tapering into a tip $\frac{1}{4}$–$\frac{1}{3}$ mm. long, formed by the produced connective (in the first species unknown).
  Fruiting pedicels glabrous, the lower 5–8 cm. long, very slender: fruit glabrous, contracted below into a short stipe. 1. *N. orizabense.*
  Fruiting pedicels sparingly pilose: the lower 2–3 cm. long.
    Ovary and fruit finely pubescent; the latter sometimes becoming glabrate in age, distinctly constricted below into a narrow stipe-like base; leaflets broad, toothed, rarely lobed. 2. *N. Negundo.*
    Ovary and fruit glabrous; the latter slightly or usually not at all constricted below; leaflets usually lobed, with hair-tufts in the axils of the veins. 3. *N. Nuttallii.*
Branches of the season densely velutinous with short spreading hairs; anthers obtuse, merely mucronate.
  Leaflets coarsely dentate or lobed; style evident but short.
    Fruit distinctly constricted at the base into a short stipe, densely and minutely pubescent; leaflets

* Vol. 2: 129–140. 1911.

broadly oval, short-acuminate, usually merely dentate; the lateral ones often oblique at the base. 4. *N. texanum*

Fruit not at all or slightly constricted at the base; leaflets lanceolate, ovate or obovate, or the terminal one rhombic, long-acuminate, usually more or less lobed.

Fruit glabrous or with a few scattered hairs, similar to those of the pedicels; mucro of the anthers minute or obsolete; leaflets glabrate above in age.

Racemes seldom more than 1 dm. long; wings scarcely at all decurrent on the body of the fruit. 5. *N. interius.*

Racemes in fruit 1.5–2 dm. long; wings decurrent on the body of the fruit almost to the bottom of the sinus. 6. *N. Kingii.*

Fruit densely puberulent; mucro of the anthers more distinct, nearly 1/4 mm. long; leaflets densely pubescent on both sides. 7. *N. californicum.*

Leaflets sharply and evenly serrate except towards the base; style obsolete. 8. *N. mexicanum.*

1. **Negundo orizabense** Rydb. sp. nov.

A tree with glabrous, brownish twigs; leaves 3-foliolate; pedicels slender, glabrous, 5–10 cm. long; leaflets thin, glabrous or with a few scattered hairs on the ribs below, acuminate at both ends, serrate above the middle, with broadly ovate teeth directed forward and mucronate; the terminal leaflet rhombic-oval, 5–10 cm. long, with petiolules 1–2 cm. long; the lateral ones lanceolate, oval or oblanceolate, short-petioluled; racemes in fruit 2 dm. long or more, the pedicels very long and slender, the lower 5–8 cm. long; samaras ascending, glabrous; body oblong, about 1 cm. long and 4 mm. wide, acute but not constricted at the base, with one strong and several weak longitudinal veins; wing about 2 cm. long and nearly 1 cm. wide, somewhat incurved above, not decurrent on the body.

Mexico: Orizaba, 1853 and 1855, *Fred. Müller* (type, in herb. Columbia University).

2. **Negundo Negundo** (L.) Karsten, Deuts. Fl. 596. 1880–3*

Distribution: From Ontario and Vermont to Georgia, Missouri and Illinois.

3. **Negundo Nuttallii** (Nieuwl.) Rydb.

Acer fraxinifolium Nuttall, Gen. N. Am. 1: 253. 1818. Not *Negundium fraxinifolium* Raf. 1808.

* For other synonyms see Nieuwland, American Midland Naturalist 2: 136. 1911.

Rulac Nuttallii Nieuwl. Am. Midl. Nat. **2**: 137. 1911.

DISTRIBUTION: From Michigan and Ohio (?) to Kansas, Colorado and Montana.

4. **Negundo texanum** (Pax) Rydb.

Acer Negundo texanum Pax; Bot. Jahrb. **7**: 212. 1886.
Acer californicum texanum Pax; Bot. Jahrb. **11**: 75. 1889.
Rulac texana Small, Fl. SE. U. S. 743. 1903.

DISTRIBUTION: Texas and Oklahoma.

5. **Negundo interius** (Britton) Rydb.

Rulac texana Small, Fl. SE. U. S. 743, in part. 1903. Not *Acer texanum* Pax. 1886.
Acer interior Britton, N. Am. Trees 655. 1908.

DISTRIBUTION: From Saskatchewan and Manitoba to Nebraska, New Mexico, Arizona and Montana. Nieuwland gives *Negundo Fraxinus* Bourgeau* as a synonym under this. At the place referred to Bourgeau enumerates a number of genera collected on May 6. Evidently a comma is omitted between *Negundo* and *Fraxinus*.

6. **Negundo Kingii** (Britton) Rydb.

Acer Kingii Britton, N. Am. Trees 656. 1908.
Rulac Kingii Nieuwl. Am. Midl. Nat. **2**: 139. 1911.

DISTRIBUTION: Utah and Arizona.

7. NEGUNDO CALIFORNICUM T. & G. Fl. N. Am. **1**: 250. 1838

Acer californicum Dietr. Syn. **2**: 1283. 1840.
Rulac californica Nieuwl. Am. Midl. Nat. **2**: 139. 1911.

DISTRIBUTION: California and according to Nieuwland extending into northern Mexico.

8. NEGUNDO MEXICANUM DC. Prod. **1**: 546. 1824

Acer mexicanum Pax; Bot. Jahrb. **7**: 212. 1886. Not *Acer mexicanum* A. Gray. 1861.
Rulac mexicana Nieuwl. Am. Midl. Nat. **2**: 140. 1911.

DISTRIBUTION: Southern Mexico to Guatemala.

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* Journ. Linn. Soc. **4**: 9. 1859.

RHAMNACEAE

Rhamnus betulaefolia Greene is to be added to the flora; it was collected in southeastern Utah in the summer of 1911 by Professor Garrett and myself.

MALVACEAE

Dr. Greene* in segregating *Eremalche* from *Malvastrum* made this statement: "and that there exists so much as one real *Malvastrum* north of the Mexican border, I hold to be doubtful."

A little investigation in the history of the genus would show that this statement is untenable. It is evident that Dr. Gray did not base his conception of the genus *Malvastrum* on the section *Malvastrum* of *Malva* of De Candolle, for this section contains the typical species of *Malva* also.

The first subsection of this section of De Candolle's is *Chrysanthae*, and some species of this subsection must be regarded as the type of *Malva* section *Malvastrum* DC. Of this subsection Dr. Gray remarked: "If the yellow flowered species with a somewhat different habit and usually a manifest persistent involucre, which forms a second section (the *Chrysanthae* DC., etc.), are correctly referred to this genus, it will comprise a large number of species from tropical and South America, which need an elaborate revision. I enumerate below merely the North American species which are known to me." Furthermore, Dr. Gray did not include in his genus a single species of *Malva* given by De Candolle. This shows that Dr. Gray based his genus on the North American species and in publishing the genus he gave the name as "MALVASTRUM *Nov. Gen.*," without citing De Candolle's section, although he had referred to it a few pages before in a footnote under *Callirrhoe*. As the type of the genus *Malvastrum*, therefore, we must desigate the first given binomial under *Malvastrum*, which is *M. coccineum*. Of the other species included in the original publication *M. Fremontii* Torr., *M. Wrightii* A. Gray, *M. grossulariaefolium* (Hook.) A. Gray, *M. angustum* A. Gray, *M. Munroanum* (Dougl.) Gray, and *M. spicatum* (L.) Gray are plants of the United States. I agree with Dr. Greene that *M. rotundifolium* A. Gray and *M. exile* A. Gray should not be included in *Malvas-*

* Leaflets 1: 207. 1906.

trum; but I believe that that genus should be merged in *Sphaeralcea. Malvastrum coccineum,* the type of the genus, has the habit of the typical species of *Sphaeralcea.* The fruit is also the same except that the empty non-reticulate portion of the carpel is much reduced. *M. grossulariaefolium* and *M. Munroanum* with little more developed upper portions have been tossed back and forth between the genera *Malvastrum* and *Sphaeralcea.* Six species should be transferred from *Malvastrum* to *Sphaeralcea* under the following names.

Sphaeralcea grossulariaefolia (H. & A.) Rydb.

(?) *Malva Creeana* Graham, Bot. Mag. *pl. 3698.* 1838.
Sida grossulariaefolia Hook. & Arn. Bot. Beech. Voy. 326. 1841.
Malvastrum grossulariaefolium A. Gray, Mem. Am. Acad. **4**: 21. 1849.
Sphaeralcea pedata Torr. Mem. Am. Acad. **4**: 23. 1849.
Malvastrum coccineum grossulariaefolium Torr. Stansb. Exped. 384. 1852.

Sphaeralcea dissecta (Nutt.) Rydb.

Sida dissecta Nutt.; T. & G. Fl. N. Am. **1**: 235. 1838.
Malvastrum coccineum dissectum A. Gray, Pl. Wright. **1**: 17, in part. 1852.

Sphaeralcea coccinea (Nutt.) Rydb.

Malva coccinea Nutt. Fras. Cat. 1813.
Cristaria coccinea Pursh, Fl. Am. Sept. 454. 1814.
Sida coccinea DC. Prod. **1**: 465. 1824.
Malvastrum coccineum A. Gray, Mem. Am. Acad. **4**: 21. 1849.

Sphaeralcea elata (E. G. Baker) Rydb.

Malvastrum coccineum elatum E. G. Baker, Jour. Bot. **29**: 171. 1891.
Malvastrum elatum A. Nels. Bot. Gaz. **34**: 25. 1902.

Sphaeralcea digitata (Greene) Rydb.

Malvastrum coccineum dissectum A. Gray, Pl. Wright. **1**: 17, in part. 1852.
Sphaeralcea pedata angustiloba A. Gray, Proc. Am. Acad. **22**: 292. 1887.

Malvastrum digitatum Greene, Leaflets **1**: 154. 1905.
Malvastrum dissectum Cockerell, Bull. Torrey Club **27**: 87, mainly. 1900.
Malvastrum Cockerellii A. Nels. Bot. Gaz. **34**: 24. 1902.
Malvastrum dissectum Cockerellii A. Nels.; Coult. & Nels. New Man. Bot. Cent. Rocky Mts. 318. 1909.

Sphaeralcea leptophylla (A. Gray) Rydb.

Malvastrum leptophyllum A. Gray, Pl. Wright. **1**: 17. 1852.

Sphaeralcea arizonica Heller, sp. nov.

Perennial with a woody caudex branching from the base; leaf-blades reniform to cordate, 3–5 cm. long, densely stellate on both sides, obscurely lobed and crenate; inflorescence paniculate, dense, with short branches; calyx densely stellate throughout; its lobes ovate, acute, about 3 mm. long; petals pink, about 1 cm. long; carpels about 4 mm. long and 1.5 mm. wide, mucronate or short-cuspidate, oblong, only about the lowest fourth reticulate.

Differing from *S. ambigua* in the short calyx-lobes and the narrow and dense inflorescence and from *S. marginata* in the dense stellate pubescence, which extends even to the calyx.

ARIZONA: Flagstaff, June 16, 1898, *MacDougal 120* (type, in herb. N. Y. Bot. Gard.); 30 miles east of Flagstaff, July 18, 1893. *Wooton;* Fort Verde, May 4, 1888, *Mearns 225;* same locality 1887, *150*; Holbrook, June 18, 1901, *L. F. Ward;* Ash Fork, June 10, 1883, *Rusby 538.*

UTAH: St. George, Apr. 14, 1880, *M. E. Jones 1660;* proposed dam site, near Wilson Mesa, Grand Co., July 1, 1911, *Rydberg & Garrett 8386;* S. Utah, 1877, *Palmer;* 1874, *Parry 25.*

Sphaeralcea subrhomboidea Rydb. sp. nov.

Perennial with a woody caudex, branched at the base; stems stellate, 2–4 dm. high; leaf-blades rhombic in outline, 2–5 cm. long, stellate but not densely so, grayish-green, cuneate at the base, 5-ribbed, 3-cleft about half way down, the divisions 2–4-lobed; inflorescence a dense virgate panicle; calyx densely stellate, 4–5 mm. long; lobes broadly ovate, obtusish; corolla scarlet, 8–9 mm. long; fruit depressed-globose; carpels nearly round, obtuse, the lower half reticulate on the faces; seed solitary, without filiform attachment.

Nearest related to *S. grossulariaefolia* but the leaf-blades are rhombic in outline and cleft only half way down, and the terminal lobe is decidedly acute. On account of the leaf-form it may be mistaken for *S. Munroana*, but the flowers are smaller, the leaves more deeply divided, the fruit is smaller, the carpels less reniform, and the seed without filiform attachment.

UTAH: Wahsatch County, near Midway, July 6, 1905, *Carlton & Garrett 6691* (type, in herb. N. Y. Bot. Gard.); Fish Lake, around Twin Creeks, Aug. 8, 1905, *Rydberg & Carlton 7627*.

There is a group of plants in *Sphaeralcea*, however, which differs from the rest not only in habit but also in the character of the fruit. The carpels are not, as in the typical *Sphaeralcea*, divided into a lower portion, reticulate on the faces and enclosing the seeds, and an upper smooth and empty portion; the whole carpel is in this group smooth and hirsute. Dr. Greene* took out this group and made a new genus under the name of *Illiamna*. I think that this was unnecessary, for the plants are evidently cogeneric with the West Indian *Phymosia*, usually also merged in *Sphaeralcea*. If the two genera should be merged, the name for the genus would be *Phymosia*, for it is the older of the two. The species to be renamed under *Phymosia* are the following:

Phymosia acerifolia (Nutt.) Rydb.

Sphaeralcea acerifolia Nutt.; T. & G. Fl. N. Am. **1**: 228. 1838.
Illiamna acerifolia Greene, Leaflets **1**: 206. 1906.

Phymosia rivularis (Dougl.) Rydb.

Malva rivularis Dougl.; Hook. Fl. Bor.-Am. **1**: 107. 1831.
Sphaeralcea rivularis Torr. in Gray, Mem. Am. Acad. **4**: 23. 1849.
Illiamna rivularis Greene, Leaflets **1**: 206. 1906.

Phymosia grandiflora Rydb.

Sphaeralcea grandiflora Rydb. Bull. Torrey Club **31**: 565. 1904.
Illiamna angulata Greene, Leaflets **1**: 206. 1906.

Phymosia Crandallii Rydb.

Sphaeralcea Crandallii Rydb. Bull. Torrey Club **31**: 564. 1904.

* Leaflets **1**: 205–207. 1906.

Phymosia longisepala (Torr.) Rydb.

Sphaeralcea longisepala Torr. Bot. Wilkes Exped. 255. 1874.

LOASACEAE

Nuttallia* humilis (A. Gray) Rydb.

Mentzelia multiflora humilis A. Gray, Pl. Wright **1**: 74. 1852.
Touterea humilis Rydb. Bull. Torrey Club **30**: 277. 1903.

Nuttallia integra (M. E. Jones) Rydb.

Mentzelia multiflora integra M. E. Jones, Proc. Calif. Acad. II. **5**: 689. 1895.
Touterea integra Rydb. Fl. Colo. 235. 1906.

Nuttallia Rusbyi (Wooton) Rydb.

Mentzelia Rusbyi Wooton, Bull. Torrey Club **25**: 261. 1898.
Touterea Rusbyi Rydb. Bull. Torrey Club **30**: 276. 1903.

Nuttallia lobata Rydb. sp. nov.

Perennial with a thick root; stems strict, glabrous or nearly so, white and shining, 3–4 dm. high; leaves 5–8 cm. long, 5–8 mm. wide, narrowly oblanceolate, sinuately toothed or lobed with short triangular lobes; sepals lanceolate, acuminate, 8–10 mm. long; flowers diurnal, subtended by narrowly linear bracts; petals golden yellow, spatulate, obtuse, 12–18 mm. long; petaloid staminodia similar and almost as large; filaments numerous, the outer dilated; capsule 15 mm. long, 8–9 mm. thick, acute, almost turbinate at the base; seeds suborbicular, broadly winged.

This species is related to *N. multiflora* (Nutt.) Greene and *N. pterosperma* (Eastwood) Greene. It differs from the former in the narrow merely toothed or lobed not pinnatifid leaves; from the latter in the acute teeth or lobes of the leaves and the capsule, which is acute not rounded at the base, and from both in the glabrous stem.

UTAH: Near St. George, 1877, *Palmer 172* (type, in herb. Columbia Univ.); 1874, *Parry 76;* 1902, *Goodding 776.*

Nuttallia acuminata Rydb. sp. nov.

Stout biennial; stem 3–10 dm. high, straw-color, white in age, rather dull, densely villous with barbed hairs; lower leaves

* "*Nuttallæ*" Rafin. Am. Mo. Mag. (1818): 175. 1818; "*Nuttallia*", Greene. Leaflets **1**: 209. 10 Ap. 1906.

oblanceolate, 1–2 dm. long, sinuately dentate, densely scabrous with triangular teeth; upper stem-leaves lanceolate, long-acuminate, pinnatifid with lanceolate or rarely triangular lobes, the lower ones of which are usually large and salient, the base of the leaves, therefore, being very broad and truncate; flowers diurnal; their bracts narrowly linear, entire or with a few narrow lobes; sepals 2–3 cm. long, lance-subulate, long-acuminate, light yellow, about 5 cm. long; outer filaments slightly dilated, the rest filiform, three fourths as long as the petals; petaloid staminodia none; capsule 4 cm. long, 1 cm. thick; seeds obovate, winged.

This species has been confused with *N. laevicaulis* (Hook.) Greene, but differs in the pubescent, duller stem (in *N. laevicaulis* this is glabrous or with a few scattered stiff hairs, very white and shining), broader petals, more deeply divided upper stem-leaves, which are characterized by their acumination and broad almost subhastate bases. *N. acuminata* extends farther eastward and northward than *N. laevicaulis* and is lacking in California.

IDAHO: Spokane River, Kootenai County, 1892, *Sandberg, MacDougal & Heller 651* (type, in herb. N. Y. Bot. Gard.); Palouse County and Lake Cœur d'Alene, *Aiton 6015*.

MONTANA: Emigrant Gulch, 1897, *Rydberg & Bessey 4546;* Sedan, 1902, *W. W. Jones;* Garrison, 1895, *Rydberg 2737*, and *C. L. Shear 5248;* Helena, 1892, *Kelsey*.

WYOMING: Between Sheridan and Buffalo, 1900, *Tweedy 3617;* Gardiner River, 1899, *Aven Nelson & Elias Nelson 6000*.

UTAH: City Creek, 1883, *Leonard 116 and 227;* Beck's Hot Spring, 1905, *Garrett 1595;* Antelope Island and Stansbury Island, *Stansbury*.

WASHINGTON: Loon Lake, 1897, *Winston;* Spokane, 1902, *Kraeger 529*.

ONAGRACEAE

Boisduvalia salicina (Nutt.) Rydb.

Oenothera densiflora β T. & G. Fl. N. Am. **1**: 505. 1840.
Oenothera salicina Nutt. in T. & G. *loc. cit.*, as a synonym.

This is quite different in habit from the typical *B. densiflora* (Lindl.) S. Wats., having the foliage-leaves narrow, linear or linear-lanceolate. It has a much more northern and eastern range, extending into British Columbia and Idaho.

Epilobium latiusculum Rydb. sp. nov.

Epilobium Drummondii latiusculum Rydb. Mem. N. Y. Bot. Gard. 1: 276. 1900.

To the characters given in the original description may be added that the leaves are distinctly petioled, not sessile as in *E. Drummondii*.

Epilobium platyphyllum Rydb. sp. nov.

Epilobium glaberrimum latifolium Barbey, Bot. Calif. 1: 220. 1876. Not *E. latifolium* L. 1753.

Epilobium paniculatum, as usually understood, contains several forms or species, connecting on one hand with *E. minutum*, on the other with *E. jucundum*. In order to facilitate the further study of the groups, I give the following key of the Rocky Mountain forms.

Tube of the hypanthium funnelform, 1–3 mm. (rarely 4 mm.) long.
- Petals white only slightly exceeding the calyx, 2–3 mm. long; capsule glabrous; tube of hypanthium 1–1.5 mm. long. — 1. *E. Tracyi.*
- Petals pink or purple, 3.5–7 mm. long, about twice as long as the calyx.
  - Capsule and pedicels glabrous or sparingly puberulent.
    - Leaves and bracts very thick, horny at the apex, the latter very short; capsule glabrous; pedicels short. — 2. *E. subulatum.*
    - Leaves and bracts not very thick, not horny at the apex; capsule usually puberulent, at least when young; pedicels slender. — 3. *E. paniculatum.*
  - Capsule and pedicels glandular-pubescent; pedicels very short. — 4. *E. adenocladum.*

Tube of the hypanthium 4–8 mm. long, cylindric or nearly so, abruptly widening into the calyx.
- Tube of the hypanthium about 4 mm. long; petals 6–7 mm. long. — 5. *E. laevicaule.*
- Tube of the hypanthium 7–8 mm. long; petals 10–12 mm. long. — 6. *E. Hammondii.*

Epilobium Tracyi Rydb. sp. nov.

Annual; stem 3–8 dm. high, perfectly glabrous, straw-colored; leaves 2–4 cm. long, linear, entire, glabrous; tube of the hypanthium 1–1.5 mm. long, funnelform; calyx-lobes about 2 mm. long, very acute; petals white, 2–3 mm. long; capsule more or less clavate, about 1.5 cm. long, perfectly glabrous; seeds obovoid, 1.5 mm. long.

This species is related to *E. paniculatum* but differs in the small white flowers and the perfectly glabrous pod.

UTAH: Ogden, July 31, 1887, *Tracy & Evans 547* (type, in herb. N. Y. Bot. Gard.); Salt Lake City, May 1869, *Watson 396*.

OREGON: Washington County, July 4, 1894, *F. E. Lloyd*.

WASHINGTON: Spokane, July 11, 1902, *Kraeger 152*.

IDAHO: Little Potlatch River, Latah County, June 17, 1892, *Sandberg, MacDougal & Heller 477*.

MONTANA: Moraine near Polson, August 18, 1901, *Umbach*.

BRITISH COLUMBIA: Howser Lake, Selkirk Mts., June 17, 1905, *Charles H. Shaw 714*.

NEVADA: Huntington Valley, August 1868, *Watson 396*.

Epilobium subulatum (Haussk.) Rydb.

Epilobium paniculatum subulata Haussk. Monog. Epil. 247. 1884.

Epilobium laevicaule Rydb. sp. nov.

Annual; stem glabrous, 6–10 dm. high, glabrous and shining; the bark of the lower portion flaky; leaves linear or linear-lanceolate, 3–6 cm. long; the upper mostly involute, usually entire; tube of the hypanthium about 4 mm. long, rather abruptly widening into the calyx; calyx-lobes 3–4 mm. long; petals rose-colored, 6–7 mm. long; pods clavate, about 3 cm. long, glabrous or almost so; seeds obovoid, dark; coma dingy.

MONTANA: Manhattan, 1895, *Rydberg 2728* (type, in herb. N. Y. Bot. Gard.); *Shear 3114;* Big Fork, Aug. 3, 1909, *Butler 7016*.

WASHINGTON: Pullman, Aug. 5, 1893, *Piper 1631;* Spokane, Sept. 1902, *Kraeger 536* and *573*.

IDAHO: Palouse County, 1892, *G. B. Aiton 69;* Seven Devils Mountains, Aug. 5, 1899, *M. E. Jones 6317*.

Epilobium Sandbergii Rydb. sp. nov.

Perennial by means of turions; stem obtusely angled, 6–10 dm. high, finely puberulent throughout; leaves sessile, ovate, acute, dentate, 3–7 cm. long, pubescent on both sides, or glabrate beneath, except the veins; inflorescence crisp-hairy; calyx-lobes linear-lanceolate, about 5 mm. long; petals rose, 7–8 mm. long; pod 4–6 cm. long, glandular-pilose; seeds 1.5 mm. long, almost beakless; coma tawny.

It resembles somewhat *E. Palmeri*, but the flowers are nearly twice as large.

IDAHO: Moist places, valley of Mud Lake, Kootenai County, July 25, 1892, *Sandberg, MacDougal & Heller 737* (type, in herb. N. Y. Bot. Gard.).

MONTANA: Bozeman, July 22, 1895, *Rydberg 2729*.

Gayophytum Helleri Rydb. sp. nov.

Annual; stem branched with nearly erect, strict branches, 1–3 dm. high, more or less pubescent with spreading hairs; leaves linear, 0.5–2 cm. long, softly hirsutulous; pedicels very short, even in fruit scarcely more than 1 mm. long; sepals and petals scarcely 1 mm. long; capsules linear, erect, 8–10 mm. long, almost sessile, hirsutulous, not torulose; seeds about 1 mm. long, strigulose.

This resembles *G. racemosum* in habit and the pod, *G. caesiun* in pubescence and *G. lasiospermum* in the seeds.

IDAHO: Forest, Nez Perces County, July 16, 1896, *Heller 3433* (type, in herb. N. Y. Bot. Gard.).

Anogra leptophylla (Nutt.) Rydb.

Oenothera pallida leptophylla (Nutt.) T. & G. Fl. N. Am. 1: 495. 1840.

Oenothera leptophylla Nutt.; T. & G. Fl. *loc. cit.*, as a synonym.

Oenothera longissima Rydb. sp. nov.

A tall biennial; stem strict, 5–10 dm. high, densely canescent with short crinkled hairs as well as sparingly hirsute; leaves linear or narrowly linear-lanceolate, 1–1.5 dm. long, densely canescent, entire, acute at both ends, the lower short-petioled; spike rather lax; bracts linear-lanceolate, 2–5 cm. long; hypanthium tube 10–12 cm. long, densely canescent, only slightly widening upwards; sepals linear-lanceolate, about 4 cm. long; free tips about 4 mm. long; petals golden yellow, 4 cm. long; stamens and pistil of about the same length; capsule about 4 cm. long, densely canescent, slightly tapering upwards.

This is related to *O. macrosceles* A. Gray and *O. Jamesii* T. & G., but differs from the former in being canescent instead of glabrous and in the smaller and narrower bracts, and from the latter in the longer, narrower and entire-margined leaves, and in being more canescent and less hirsute. It grows on sandy river banks at an altitude of about 1,600 m.

UTAH: Armstrong and White Canyons near the Natural Bridges, Aug. 4–6, 1911, *Rybderg & Garrett 9410* (type, in herb. N. Y. Bot. Gard.).

Oenothera ornata (A. Nelson) Rydb.

Onagra ornata A. Nels. Bot. Gaz. **52**: 268. 1911.

Oenothera hirsutissima (A. Gray) Rydb.

Oenothera biennis hirsutissima A. Gray, Mem. Am. Acad. **4**. 43. 1849.

This usually has been regarded as the same as *O. Hookeri* T. & G. The type of the latter came from California, that of the former from New Mexico. In the plant common in California and the Great Basin, the free tips of the sepals are about 4 mm. long, the pubescence of the leaves is short and that of the calyx not very copious. In the type of *O. biennis hirsutissima* and other specimens from New Mexico and Colorado, the free tips of the sepals are only 2–2.5 mm. long, the pubescence of the leaves and calyx long and loose, and that of the latter very copious.

Oenothera subulifera (Rydb.)

Onagra strigosa subulata Rydb. Mem. N. Y. Bot. Gard. **1**: 279. 1900. Not *O. subulata* R. & P. 1802

Onagra Oakesiana Rydb. Fl. Colo. 244. 1906. Not *Oenothera Oakesiana* A. Gray. 1867.

Chylisma tenuissima (M. E. Jones) Rydb.

Oenothera tenuissima M. E. Jones, Proc. Calif. Acad. II. **5**: 683. 1895.

Sphaerostigma macrophyllum (Small) Rydb.

Oenothera alyssoides villosa S. Wats. Proc. Am. Acad. **8**: 591. 1873. Not *O. villosa* Thunb. 1794–1800.

Sphaerostigma alyssoides macrophyllum Small, Bull. Torrey Club **23**: 192. 1896.

AMMIACEAE

Osmorrhiza intermedia Rydb.

Washingtonia intermedia Rydb. Mem. N. Y. Bot. Gard. **1**: 289. 1900.

Glycosma maxima Rydb. sp. nov.

Perennial; stem 1 m. high or more, puberulent or glabrous, pilose at the nodes; lower leaves twice compound, first pinnate and the lower primary divisions ternate; the upper leaves ternate or twice ternate; leaflets oblong-lanceolate, 5–10 cm. long, minutely puberulent; branches of the umbels 9–12, in fruit more or less spreading; pedicels in fruit 1–1.5 cm. long; fruit fully 2 cm. long, obtuse at the base, contracted above into a beak 2 mm. long; stylopodium conical, 0.5 mm. long, about as long as the styles.

This is related to *G. occidentalis* Nutt., but the fruit is much larger (in *G. occidentalis* only 12–16 mm., rarely 18 mm. long), and the rays of the umbels are in fruit usually widely spreading, while in *G. occidentalis* they are nearly erect. The spreading rays suggest *G. ambigua* and *G. Bolanderi*, but in both these species the stylopodium is flatter.

UTAH: Mount Nebo, Aug. 15, 1905, *Rydberg & Carlton 7585* (type, in herb. N. Y. Bot. Gard.); Rocky Canyon, Provo, Aug. 16, 1887, *Tracy 684*.

MONTANA: Midvale, July 24, 1903, *Umbach 508*.

ATENIA H. & A. Bot. Beech. Voy. 349. 1840

This I think is a good genus, distinct from *Carum*. Although the fruit is almost the same, the habit is quite different. The habit of *Atenia* is the same as that of *Eulophus*. In fact it is hard to distinguish the two genera without mature fruit, both having the fascicled tuberous roots, the narrow leaf-segments, the same inflorescence and flowers. The only essential differences are the deeply concave seed-face with a central ridge and the several oil tubes in *Eulophus* and the plane face and solitary oil tubes in *Ataenia*. The following species are found in the Rocky Mountains:

ATENIA GAIRDNERI H. & A. Bot. Beech. Voy. 349. 1840

Edosmia Gairdneri Nutt.; T. & G. Fl. N. Am. **1**: 612. 1840.
Carum Gairdneri A. Gray, Proc. Am. Acad. **7**: 344. 1867.

Atenia montana (Blank.) Rydb.

Carum montanum Blank. Mont. Agr. Coll. Sci. Bot. **1**: 91. 1905.

Atenia Garrettii (A. Nels.) Rydb.

Carum Garrettii A. Nels. in Rose, Cont. U. S. Nat. Herb. **12**: 443. 1909.

Oreoxis MacDougali (C. & R.) Rydb.

Aletes MacDougali C. & R. Cont. U. S. Nat. Herb. **7**: 107. 1900.

This was doubtfully referred to *Aletes* by Coulter and Rose. The fruits in the type collection were very young and did not show their true nature. Anyhow, they showed distinct wings, a character inconsistent with the genus *Aletes.* Professor Garrett and myself collected good fruits in southeastern Utah in the summer of 1911; and these show that the plant is rather an *Oreoxis* than an *Aletes,* wings being present and these thick and corky. The two genera are, however, more closely related than has been recognized, having the same cespitose habit, the prominent calyx, teeth, etc.

Daucophyllum (Nutt.) Rydb. gen. nov.

Musenium § *Daucophyllum* Nutt.; T. & G. Fl. N. Am. **1**: 642. 1840.

Low cespitose perennials, acaulescent or nearly so, with a branched caudex. Leaves numerous, basal, or 1 or 2 cauline, pinnate or bipinnate with filiform or narrowly linear divisions. Flowers cream-colored to yellow, in dense umbels. Bracts wanting; bractlets few, narrow, linear. Calyx teeth prominent. Stylopodium wanting. Fruit ovoid or oblong, granular on the intervals. Ribs equal, rather strong, but not at all winged. Oil tubes 2 or 3 in the intervals, 4–6 on the commissural side. Seed terete or somewhat depressed; face plane.

The type, *Musenium tenuifolium* Nutt., was separated as a section in Torrey and Gray's Flora. The relationship is rather with *Harbouria* and *Aletes* than with *Musineon* Raf. The first-mentioned relationship was recognized by Coulter and Rose (see their Revision, p. 111). It differs from *Harbouria* in not having thick corky ribs and in having several oil tubes in the intervals. It is still more closely related to *Aletes,* having the same habit, although narrower leaf-segments, the main differences being, however, the solitary oil tubes in *Aletes* and 2 or 3 in each interval in *Daucophyllum,* and the concave seed face in the former and the plane one in the latter. The second species given below was included questionably in *Aletes* by Coulter and Rose; but in the number of oil tubes and the plane seed face it agrees better with *Musenium tenuifolium* Nutt. than with the typical species of *Aletes*.

Leaves bipinnate; segments filiform; bractlets not exceeding the pedicels; seed subterete. 1. *D. tenuifolium.*
Leaves pinnate; segments narrowly linear; bractlets longer than the pedicels; seeds somewhat depressed. 2. *D. lineare.*

1. **Daucophyllum tenuifolium** (Nutt.) Rydb.

Musenium tenuifolium Nutt.; T. & G. Fl. N. Am. **1**: 642. 1840.

2. **Daucophyllum lineare** Rydb. nom. nov.

Aletes tenuifolia C. & R. Cont. U. S. Nat. Herb. **7**: 108. 1900.

Coriophyllus (M. E. Jones) Rydb. gen. nov.

Cymopterus §*Coriophyllus* M. E. Jones, Cont. West. Bot. **12**: 20. 1908.

Perennial herbs with more or less fleshy root, somewhat branched rootstock covered with fibrous sheaths, and leafy stems with internodes shorter than the leaf-sheaths. Flowers yellow to purple. Bracts none; bractlets present, but narrow. Leaves pinnately dissected, subcoriaceous, rigid, not fleshy, with ovate or lanceolate, cuspidate or spinulose-tipped lobes. Calyx teeth evident. Stylopodium wanting. Fruit orbicular to oval in outline, usually emarginate at both ends, compressed laterally if at all. Ribs with broad wings. Oil tubes 1–5 in the intervals, 2–8 on the commissural side. Seeds little if at all flattened dorsally; face deeply grooved.

I agree with Mr. Marcus E. Jones that the genus *Aulospermum*, as constituted by Coulter and Rose, is a rather unnatural one, made up of two groups of quite different habit; but instead of reducing both groups to sections of *Cymopterus* as Mr. Jones did, I rather regard them as two distinct genera, and adopt for the second group the sectional name first proposed by Mr. Jones. (See the discussion in Cont. West. Bot. **12**: 19–20 and 27.) He, however, had the group under two different sectional names. The section is called *Coriophyllus* on page 20 and *Scopulicola* on page 27.

The following species are found in the Rockies and are distinguished thus:

Wings thickened at the insertion.
- Leaves ternately bipinnatifid; oil tubes solitary in each interval. 1. *C. Jonesii.*
- Leaves pinnate, with lobed or divided leaflets; oil tubes several in each interval. 2. *C. Rosei.*

Wings not thickened at the insertion.
- Flowers purplish; oil tubes 8 on the commissural side. 3. *C. purpureus.*
- Flowers greenish-yellow; oil tubes 4 on the commissural side. 4. *C. Betheli.*

1. **Coriophyllus Jonesii** (C. & R.) Rydb.

Cymopterus Jonesii C. & R. Rev. N. Am. Umb. 80. 1888.
Aulospermum Jonesii C. & R. Cont. U. S. Nat. Herb. **7**: 178. 1900.

2. **Coriophyllus Rosei** (M. E. Jones) Rydb.

Aulospermum Rosei M. E. Jones; C. & R. Cont. U. S. Nat. Herb. **7**: 179. 1900.

3. **Coriophyllus purpureus** (S. Wats.)

Cymopterus purpureus S. Wats. Am. Nat. **7**: 300. 1872.
Aulospermum purpureum C. & R. Cont. U. S. Nat. Herb. **7**: 178. 1900.

4. **Coriophyllus Betheli** (Osterhout) Rydb.

Aulospermum Betheli Osterhout, Muhlenbergia **6**: 46. 1910.

PSEUDOCYMOPTERUS C. & R.

This genus is one of the most unnatural in Coulter & Rose's Monograph. Jones* called attention to this fact, although he included the genus, as well as *Oreoxys*, *Rhysopterus*, *Aulospermum*, and *Pteryxia* in *Cymopterus*, and does not go to the bottom of the facts. The genus as constituted by Coulter and Rose contains at least three distinct groups of plants of little relationship to each other. The first group contains *Pseudocymopterus montanus* and its close relatives; the second of *P. anisatus* and *P. aletifolius*, and perhaps *P. Hendersonii*, which I do not know; and the third of *P. bipinnatus* and probably *Cymopterus nivalis* S. Wats., of which the fruit is unknown. *P. montanus* is the type of the genus, which latter therefore must be restricted to it and its relatives. Jones

* Cont. West. Bot. **12**: 24–29. 1908.

includes *P. anisatus* and *P. bipinnatus* in his section *Oreoxis*, but the genus *Oreoxis* has all ribs corky and the lateral ones scarcely more prominent than the dorsal ones, the fruit is not flattened dorsally, the styles and sepals are erect. In *Pseudocymopterus anisatus* the lateral wings are very prominent, the dorsal ribs narrowly winged or some of them merely acute, the styles are recurved, the sepals spreading and one or two of them larger than the rest, and the fruit is decidedly flattened dorsally. The plant is more related to *Aletes* than to *Oreoxis*, and *P. aletifolius* connects it with that genus. It can not be placed in *Aletes*, however, for in that genus the fruit is not compressed and the ribs not winged. It would be much better to include *P. anisatus* and *P. aletifolius* in *Pteryxia*, as they have the foliage and nearly the same fruit as in that genus, but the strictly acaulescent plant, the narrow and thick wings of the fruit and the very prominent and unequal calyx-teeth would make it rather abnormal even in that genus. Although it does not differ so much in the technical characters of the fruit from the typical *Pseudocymopterus*, the habit is quite different, so also the texture of the leaves, and in *Pseudocymopterus* the sepals are minute. It is better to regard *P. anisatus* as a type of a new genus.

Pseudopteryxia Rydb. gen. nov.

Densely cespitose, strong-scented, acaulescent perennials with multicipital caudices covered with numerous sheaths of old leaves. Leaves pinnatifid or bipinnatifid with thick, firm, pungent divisions. Flowers yellow; involucres wanting; bractlets linear-subulate, pungent. Calyx-teeth very prominent, spreading, unequal, one or two much longer than the rest. Stylopodium wanting. Fruit oblong, glabrous. Ribs thick, the dorsal and intermediate ones sharp or some of them with narrow wings; the lateral ones with broader wings, distinct from those of the other carpel. Carpels flattened dorsally. Oil tubes 1–3 in the intervals, 2–4 on the commissural side. Seed face plane.

Pseudopteryxia anisata (A. Gray) Rydb.

Cymopterus (?) *anisatus* A. Gray, Proc. Acad. Phila. 1862: 63. 1863.

Pseudocymopterus anisatus C. & R. Rev. N. Am. Umb. 75. 1888.

Pseudopteryxia longiloba Rydb. sp. nov.

Densely cespitose perennial with a thick root and short caudex, covered by numerous old leaf-sheaths and petioles; leaves twice pinnatifid, with linear-subulate, pungent divisions; peduncles 2–3 dm. high, stout; bractlets linear-subulate, spreading, often 1 cm. long; flowers yellow; fruit about 6 mm. long; lateral wings thick, narrow, some of the wings of the dorsal ribs often fully as broad; calyx-teeth less prominent than in *P. anisata*.

This is closely related to *P. anisata*, differing in the larger fruit (in *P. anisata* about 4 mm. long), and longer leaf-segments. On account of the long leaf-segments, specimens collected in flower by Carlton and myself were mistaken for *Cynomarathrum Nuttallii* (A. Gray) C. & R.; but good fruit was received in the summer of 1911.

UTAH: Abajo Mountains, Aug. 17, 1911, *Rydberg & Garrett 9761* (fruit; type, in herb. N. Y. Bot. Gard.); also *9760* (fruit); La Sal Mountains, July 7 and 17, *8724* and *9015* (young fruit); Mountains north of Bullion Creek, near Marysvale, July 23, *Rydberg & Carlton 7085* and *7096* (flowers); Mount Ellen, July 24 and 25, 1894, *M. E. Jones 5677* (fruit, but poor).

Pseudopteryxia aletifolia Rydb.

Pseudocymopterus aletifolius Rydb. Bull. Torrey Club **31**: 574. 1904.

Neither can *Pseudocymopterus bipinnatus* be retained in the genus; in fact, it is still more out of place. Not only is the habit strikingly different from that of *P. montanus*, but the fruit is not, as Coulter and Rose described it, "moderately flattened dorsally," for the fruit when well developed is moderately flattened laterally, which places it in the other division of the family. Furthermore, the seed face is concave, the bractlets broad and scarious, and a stylopodium, although strongly flattened, is present. Were it not for these characters of the fruit the plant could be placed in the same genus as *P. anisatus*. As it is, its relationship is with *Daucophyllum* and *Aletes*. I would place it in *Daucophyllum* were it not for the winged ribs, the concave seed face and the reflexed style. The fruit is nearer that of *Aletes*, but the oil tubes are several, the ribs winged, styles reflexed and stylopodium present. If a person were using the key given by Coulter and Rose in their Monograph and were trying to determine the plant, the key would lead to *Aulospermum* or *Phellopterus*, to either of which genera it is not even closely related. Mr. Jones included it in *Oreoxis*, to which I admit it is related, but the ribs are not corky, the stylopodium present, the styles reflexed, the flowers white, not yellow, and the bractlets scarious.

Pseudoreoxis Rydb. gen. nov.

Low cespitose acaulescent perennials, with branched caudex. Leaves bipinnate; the segments more or less cleft with small lanceolate divisions. Flowers white in small umbels; bracts wanting; bractlets ovate or lanceolate, cuspidate or abruptly acuminate, scarious, white with a green midrib. Calyx-teeth evident but small. Stylopodium present but low and flat. Styles reflexed. Fruit somewhat flattened laterally, oblong. Ribs all with narrow wings, the lateral ones scarcely wider. Oil tubes 3 or 4 in the intervals, 6–8 on the commissure. Seed face slightly concave.

Pseudoreoxis bipinnatus (S. Wats.) Rydb.

Cymopterus bipinnatus S. Wats. Proc. Am. Acad. **20**: 368. 1885.
Pseudocymopterus bipinnatus C. & R. Rev. N. Am. Umbel. 75. 1888.

Pseudoreoxis nivalis (S. Wats.) Rydb.

Cymopterus nivalis S. Wats. Bot. King. Exped. 123. 1871.

I do not hesitate to refer this species to the same genus as *P. bipinnatus*, although the fruit is unknown, for the habit, and flowers are so closely resembling those of *P. bipinnatus*.

Cynomarathrum latilobum Rydb. sp. nov.

Acaulescent perennial with densely cespitose caudex covered by old broad leaf-sheaths; leaves about 1 cm. long, pinnate, glabrous; leaflets entire or 2- or 3-cleft into broadly lanceolate, reticulate, thick, pointed segments 5–15 mm. long; peduncles 1–1.5 dm. long, stout; rays 1–2 cm. long; bractlets linear or lance-linear, 5–6 mm. long; flowers apparently straw-colored or ochroleucous; fruit about 9 mm. long, 6 mm. wide; lateral wings about as broad as the body; dorsal ribs filiform or some of them narrowly winged; oil tubes 2–4 in the intervals, 4–6 on the commissure, rather obscure.

The fruit of this species is intermediate between that of *C. Nuttallii* and *C. Parryi*, but the plant differs from both, as well as from all the known species, in the broad segments of the leaves.

The segments resemble those of some species of *Cogswellia* of the *C. triternata* group, but the leaves are pinnate, not ternate, the plant has the densely cespitose, sheath-covered caudex characteristic of *Cynomarathrum*, and the fruit is of that genus, having some of the dorsal ribs winged, and the calyx-teeth are prominent. It grows on sides of canyons at an altitude of 1,600 m.

UTAH: Proposed dam site, near Wilson Mesa, Grand County, Utah, July 1, 1911, *Rydberg & Garrett 8371* (fruit; type, in herb. N. Y. Bot. Gard.); also *8414* (withered flowers).

Cogswellia simplex (Nutt.) Rydb.

Peucedanum triternatum platycarpum Torr. Stansb. Rep. 389. 1852.
Peucedanum simplex Nutt.; S. Wats. Bot. King. Exped. 129. 1871.
Lomatium platycarpum C. & R. Cont. U. S. Nat. Herb. **7**: 226. 1900.
Cogswellia platycarpa (Torr.) M. E. Jones, Cont. West. Bot. **12**: 32. 1908.

It was unfortunate that an amendment to the Rochester Code ever was passed at Madison, by which a varietal name could supersede a specific name, and I am glad that the amendment mentioned has been recalled and that we can return to the specific name well known by a long usage.

Cogswellia leptophylla (Hook.) Rydb. sp. nov.

Peucedanum triternatum leptophyllum Hook. Lond. Journ. Bot. **6**: 235. 1847.

This species is related to *C. simplex*, *C. triternata*, and *C. robustior*. In general habit, it resembles most the second, but the leaflets are narrower, the fruit is shorter and relatively broader and puberulent. *C. simplex* has less compound leaves, broader leaflets, larger and glabrous fruit; *C. robustior* has much broader and more spreading leaflets, longer fruit with very narrow wing.

MONTANA: Helena, June–July, 1891, *Kelsey;* also May, 1890; University campus and hillsides, Missoula, 1901, *MacDougal 130;* Old Sentinel, June 12, 1901, *MacDougal;* Deer Lodge, June, 1888, *Traphagen;* Mt. Ascension, Helena, 1909, *Butler 4057*.

IDAHO: Hills near Boise, June 7, 1892, *Isabel Mulford;* Weiser, April 18, 1900, *M. E. Jones 6336*.

NEW YORK BOTANICAL GARDEN.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN — No. 157

NEW FERNS FROM TROPICAL AMERICA—II

MARGARET SLOSSON

NEW YORK
1913

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New ferns from tropical America—II

Margaret Slosson

(with plate 3)

The two species of *Dryopteris* here described for the first time belong to the group of *D. pubescens*. Both are from Jamaica, and each bears a most curious and misleading resemblance to the other.

For the privilege of describing the first I am indebted to the kindness of Mr. William R. Maxon. This species is based on a single sheet, representing a rootstock and three leaves, two detached, originally from the Jenman Herbarium, labelled *Nephrodium luridum* Jenman, in Jenman's hand. It may be described as follows:

Dryopteris lurida (Jenman) Underwood & Maxon sp. nov. *Nephrodium luridum* Jenman MS.

Rhizome creeping, furnished with blackish rigid lanceolate or lance-linear acuminate scales up to 6 mm. long, with occasional unicellular gland-like processes and jointed cilia on their margins; similar scales on bases of the stipes; fronds clustered, pubescent, glandular throughout with capitate, often long-stalked and jointed, sometimes forked glands; stipes slender, up to 31.5 cm. long, dark brown at base, upwards brownish or stramineous or greenish, grooved on face; laminae up to 25 cm. long, up to 16.5 cm. broad, green, tinged with olive, ovate-deltoid, tripinnate, abruptly narrowed above at about the third or fourth pair of pinnae, their apices acute or acuminate, serrate, giving rise gradually to the pinnae and pinnules; pinnae alternate or opposite, oblique, stalked, mostly asymmetrical, those above the basal mostly ovate-lanceolate to oblong-lanceolate, the second or third pair often subequilateral, those above somewhat cut away beneath at base, the basal pair broadly deltoid or ovate-deltoid, up to 9 cm. broad at base, its inner inferior 2–5 pinnules on either side much longer than the corresponding superior ones and sometimes subbipinnate at base; other pinnules parallel with or overlapping the costa on the inner side, somewhat cut away beneath at base, acute, the larger stalked and obliquely pinnatifid into serrate or entire lobes, the smaller subdimidiate, serrate and decurrent; texture thin, membrano-herbaceous; pubescence white or whitish, setaceous, multicellular, the facial grooves of the stipes and the backs of the costae thickly coated with short fine soft hairs which spread part way up the midribs of the pinnules, larger coarser stiffer hairs scattered over the stipes, costae, backs of the veins on the under surface of the lamina, and between the veins on its upper surface; veins clearly visible, pinnate; sori apical on the veinlets, midway between the midvein and the margin of the lamina, sterile veinlets mostly extending almost to the margin; indusia glandular, not setose; sporangia glabrous; spores coarsely papillose. [PLATE 3, FIGURE 1.]

Type in the Underwood Herbarium at the New York Botanical Garden, collected in Jamaica "1874–79."

The following specimens also are in the Underwood Herbarium:

JAMAICA: Mt. Diabolo, altitude 609 meters, April 2, 1903, *Underwood 1825;* vicinity of Hollymount, Mt. Diabolo, May 9, 1903, *Maxon 1957;* vicinity of Hollymount, altitude about 750 meters, May 25–27, 1904, *Maxon 2311, 2260.*

Dryopteris leucochaete Slosson sp. nov.

Rhizome creeping, slightly chaffy; fronds clustered, pubescent and glandular; stipes up to 35.5 cm. long, brown and slightly chaffy at base, above greenish to brownish, grooved on face; scales soft, pale brown, lanceolate, acuminate, up to 3 mm. long, with slightly ciliate or subglandular margins; laminae up to 28 cm. long and 25 cm. broad, mostly subpentagonal, commonly quadripinnate, abruptly narrowed above, apices mostly long-acuminate and serrate; pinnae oblique, stalked, asymmetrical, basal pair ovate-deltoid to deltoid; pinnules oblique, stalked to decurrent, several of the inferior elongate in the basal pinnae and shortened in the upper; segments oblique, stalked to decurrent, unequally ovate to subtrapezioid, cut away at base, pinnate or obliquely pinnatifid to serrate; glands capitate, often jointed, sometimes forked; pubescence white, setaceous, multicellular, fine and short hairs abundant on the groove of the stipe, backs of the costae, and partly on the midribs of the pinnules, larger, coarser, scattered hairs on the general surface of the stipes, costae, and backs of the veins, and between the veins on the upper surface of the lamina; veins pinnate; sori apical on the veinlets, midway between the midvein and margin of the lamina; indusia conspicuously setose and glandular; sporangia glabrous; spores papillose. [PLATE 3, FIGURE 2.]

Type in the Underwood Herbarium at the New York Botanical Garden, collected on shady forest land in Peckham Woods, Clarendon, Jamaica, altitude 762 meters, May 21, 1912, *William Harris 11023*.

This species differs from *D. lurida* chiefly in its smaller, soft, pale, almost tow-colored scales, its larger, more finely divided lamina, and its setose indusia. Additional specimens are: Jamaica; vicinity of Troy, altitude 600–660 meters, June 28, 1904, *Maxon 2860;* in rocky woodland, near Troy, altitude 701 meters, June 28, 1904, *Harris 8710*.

Explanation of plate 3

FIG. 1. *Dryopteris lurida;* Jamaica; parts of the type specimen, reduced.

FIG. 2. *Dryopteris leucochaete;* Jamaica; leaf, reduced, *Maxon 2860*.

Slosson: New ferns from tropical America

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN — No. 158

STUDIES ON THE WEST INDIAN VERNONIEAE, WITH ONE NEW SPECIES FROM MEXICO

HENRY ALLAN GLEASON

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1913

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Studies on the West Indian Vernonieae, with one new species from Mexico

HENRY ALLAN GLEASON

Seven years ago, in the Revision of the North American Vernonieae,* forty-three species and one variety of *Vernonia* were recognized from the West Indies, together with several species of other genera. Since that time, the New York Botanical Garden has been actively engaged in the systematic exploration of these islands, especially Cuba, and has accumulated much valuable material. Director N. L. Britton has recently extended to me the facilities of the Garden, and has given me the opportunity to examine the new material in this tribe of Carduaceae. The results of this study are herewith presented.

Of the forty-four species and varieties recognized in the revision, three have been found untenable and are reduced to synonymy: *V. sublanata* Gleason, *V. Thomae* Benth., and *V. Sintenisii* (Urban) Gleason. The variety has been raised to specific rank. Four old species, not recognized in the revision, are shown by the recent collections to be distinct, and are admitted as species: *V. acuminata* Lessing, *V. Ottonis* Sch.-Bip., *V. Wrightii* Sch.-Bip., and *V. fruticosa* (L.) Sw. For the identification of the latter, we are indebted to Dr. Urban, who has also described a new species, *V. Tuerckheimii*. The collections at the Garden, supplemented by some material loaned by the Gray Herbarium and the Missouri Botanical Garden, are also found to contain seventeen

* Bull. N. Y. Bot. Gard. 4: 144–243. 1906.

[The BULLETIN for May 1913 (40: 193–248. *pls. 9–14*) was issued May 20; the

new species, which are here described. The total number of species of *Vernonia* recognized from the West Indies at the present time is therefore sixty-three. In addition, an Asiatic species escaped or adventive in Guadeloupe has been found to differ from *Vernonia* in particulars important enough to warrant its segregation, and a new species of the related genus *Eremosis* has been described from Mexico.

CYANTHILLIUM Blume, Bijdr. Flora Nederl. Indie 889. 1826

Isonema Cass. Bull. Soc. Philom. **1817**: 152. 1817. Not *Isonema* R. Br., 1809.

Cyanthyllium Blume, Flora Javae 1: vi. 1828.

Cyanopis Blume, Flora Javae 1: vi. 1828; DC. Prodr. 5: 69. 1836.

Cyanopsis Endl. Ench. 232. 1841. Not *Cyanopsis* Cass. Bull. Soc. Philom. **1817**: 200. 1817.

Claotrachelus Zoll. Nat. en Geneesk. Arch. Neêrl. Indie **2**: 565. 1845, *fide* Hoffman, in Engl. & Prantl, Nat. Pfl.-Fam.

The genus differs from *Vernonia* in its very fragile, uniseriate pappus, and its 4–5-angled achenes.

Cyanthillium chinense (Lam.) comb. nov.

Eupatoria conyzoides foliis glabris summo caule ramosior, lamii folio flore purpureo Pluk. Phytographia *pl. 177. f. 2.* 1691.

Conyza chinensis Lam. Encyc. 2: 83. 1786.

Conyza patula Ait. Hort. Kew. 3: 184. 1789.

Isonema ovata Cass. Dict. Sc. Nat. 24: 25. 1822.

Conyza odorata Willd. in Spreng. Syst. 3: 511. 1826.

Cyanthillium villosum Blume, Bijdr. Flora Nederl. Indie 889. 1826.

Cyanthillium pubescens Blume, Bijdr. Flora Nederl. Indie 890. 1826.

Centratherum chinense Less. Linnaea **4**: 320. 1829.

Vernonia chinensis Less. Linnaea **6**: 105, 674. 1831.

Cyanopis pubescens DC. Prodr. 5: 69. 1836.

Cyanopis villosa DC. Prodr. 5: 69. 1836.

Claotrachelus rupestris Zoll. Nat. en Geneesk. Arch. Neêrl. Indie **2**: 565. 1845.

As long ago as 1829 Lessing mentioned a specimen of this species from the "insulis Caribaeis" in Willdenow's herbarium. The herbarium of the New York Botanical Garden now contains a specimen from Guadeloupe, *Duss 4032*, where it occurs in a single locality. It is therefore admitted as a member of the North American Flora.

SPECIES-GROUP ARBORESCENTES

Vernonia icosantha DC. Occurs also in Guadeloupe Island, *Duss 2812*.

Vernonia arborescens (L.) Sw. This species, typically of Jamaica, occurs also in Grand Cayman, *Hitchcock*, in the herbarium of the Missouri Botanical Garden.

Vernonia amaranthina sp. nov.

Apparently herbaceous and freely branched, height not reported; stem and branches straight, striate, closely and softly pubescent or tomentulose, the branches ascending; leaves spreading, firm, rather dull green, ovate-lanceolate to narrowly oblong-elliptical, the principal ones 7–9 cm. long by 2–3 cm. wide, acute or short-acuminate, entire or somewhat irregular at the margin, but not serrate, narrowed to an acute base, minutely papillose-pubescent and scabrellate to the touch above, pubescent, especially along the veins, and minutely glandular beneath, veins conspicuous, elevated beneath, the lateral ones strongly ascending; petioles definite, 5–10 mm. long, pubescent or tomentulose; inflorescence freely branched and spreading; cymes short, naked below and bearing 2–5 heads aggregated near the tip, or separated by internodes less than 1 cm. long; rameal leaves resembling the cauline but smaller, those subtending the cymes narrowly oblanceolate, 1–2 cm. long, those subtending the heads linear to narrowly oblanceolate, shorter than or barely equaling the involucre; heads 21–29-flowered, sessile; corolla purple; involucre campanulate, about 5 mm. high, its scales purplish, thinly pubescent, irregularly imbricated, the outer triangular to ovate, sharply acute and somewhat cuspidate, the inner oblong, rounded to a mucronulate tip; achenes densely hirsute, 1.5 mm. long; pappus white, 4 mm. long, the outer series conspicuous.

Type, *E. G. Britton 2897*, from "Greenland," Jamaica, March 13, 1908, in the Herbarium of the New York Botanical Garden. *Britton & Hollick 2133*, from Green Island, Jamaica, is also referred here. The latter is a virgate plant 2 meters high, and the inflorescence is consequently small and composed of relatively few heads. It differs in no essential way from the type.

V. amaranthina is distinguished from *V. arborescens*, its nearest relative, by the rounded and mucronulate inner scales of the involucre and its short contracted cymes, contrasting with the acute or acuminate inner scales and elongated cymes of *V. arborescens*.

SPECIES-GROUP ARARIPENSES

A. Leaves of a linear type, 1–5 mm. wide, one-nerved, more or less revolute.
- 1. Leaves linear to narrowly lanceolate, 3–5 mm. wide; inner scales broadest above the base, purplish or brown; middle and outer scales glabrate; pappus tawny or pale brown. — *Vernonia araripensis.*
- 2. Leaves 1–4 mm. wide, linear; inner scales broadest near the base; all scales densely strigose, pale-green; pappus white or very pale yellowish-brown.
  - *a*. Leaves 3–8 cm. long, densely papillose-pubescent above; inflorescence divaricately branched; heads 18–21-flowered. — *Vernonia stenophylla.*
  - *b*. Leaves 1–3 cm. long, strigose-hispid above; inflorescence slender, virgate; heads 11-flowered. — *Vernonia corallophila.*

B. Leaves 4–20 mm. wide, narrowly oblong to oblong-obovate, mucronate; inner scales broadest above the base; all scales strigose-pubescent; pappus white or nearly so.
- 1. Leaves narrowly oblong with parallel sides, without conspicuous lateral veins beneath. — *Vernonia angustata.*
- 2. Leaves broadest near or above the middle, veiny. — *Vernonia gnaphaliifolia.*

The status of the first three species in the key above is still open to question and may require future adjustment. Gardner's type locality for *V. araripensis* was in Brazil, and it is scarcely probable that the same species occurs in the Antilles, especially as far as Cuba or Santo Domingo. Authentic specimens of Lessing's *V. stenophylla* have not been seen, and the plants referred to his name differ in some slight features from the original description. Both species are accepted solely on the authority of certain European students of the genus.

Vernonia corallophila sp. nov.

Stem erect, herbaceous, 4 dm. high, virgate, finely striate, strigose-pubescent; leaves sessile, narrowly linear, rigid, revolute, one-nerved, 1–3 cm. long, strigose-hispid and punctate above, densely strigose-pubescent beneath; inflorescence cylindrical or sparingly branched; heads 11-flowered, in the axils of the upper leaves or rarely 2 or 3 together on a short ascending lateral cyme; bracteal leaves resembling the cauline, but reduced in size and the upper barely exceeding the heads; involucre turbinate, 5–6 mm. high, its scales all straight, erect, very loosely imbricated, strigose-pubescent, the outer subulate, the inner narrowly oblong, long-acuminate; achenes pubescent, 2 mm. long; pappus nearly white, the inner series 4–5 mm. long.

Type, *Britton 1939*, from a coral limestone beach at the United States Naval Station, Guantanamo Bay, Oriente, Cuba, March 17–30, 1909, deposited in the Herbarium of the New York Botanical Garden.

The species is readily distinguished by its slender virgate inflorescence and small leaves from *V. stenophylla* with its long leaves and divaricate inflorescence.

Vernonia angustata sp. nov.

Vernonia sublanata angustata Gleason, Bull. N. Y. Bot. Gard. 4: 177. 1906.

Herbaceous, height not stated; stems slender, puberulent or thinly pubescent, sparingly branched above; leaves thin, flat, spreading, narrowly oblong with parallel sides, 3–5 cm. long, 4–8 mm. wide, obtuse or rounded, mucronate, entire, acute at the base, thinly pubescent above, closely gray-tomentose beneath, one-nerved; petioles 1–2 mm. long; cymes few, widely spreading or horizontal, simple or sparingly branched, bearing 2–7 heads each; internodes 1–2 cm. long, depressed or gently curved between the heads; bracteal leaves like the cauline, but gradually reduced in size, and the upper only 1 cm. long; heads sessile, distinctly secund, about 18-flowered; involucre broadly campanulate, 6–7 mm. high, its scales loosely and irregularly imbricated, strigose-pubescent, acuminate or sharply acute, the outer lanceolate, the inner narrowly oblong; achenes pubescent, 2 mm. long; pappus white, the inner series 6 mm. long.

VERNONIA GNAPHALIIFOLIA Rich. in Sagra, Hist. Fis. Pol. Nat. Cuba 11: 34. 1850

Vernonia sublanata Gleason, Bull. N. Y. Bot. Gard. 4: 177. 1906.

Dr. Urban has established the identity of these two species by the examination of authentic material, and they are accordingly united here. The species appears to be common and widely distributed in Cuba from the province of Havana eastward.

SPECIES-GROUP DIVARICATAE

The history of this group of Vernonieae begins with the publication of *V. divaricata* by Swartz in 1806. This was followed in 1831 by Lessing's *V. acuminata*, and no further addition was made to the group until 1906, when Gleason described *V. albicoma* and *V. expansa*. During the last half-century *V. divaricata* and *V. acuminata* have been usually considered identical. The whole group, so far as known, is confined to Jamaica, and the ample collection in the Herbarium of the New York Botanical Garden includes seven distinct species.

At the present time the chief difficulty lies in determining to which of these seven species the old names *divaricata* and *acuminata* belong. Certain characters given by the authors in their original descriptions serve to exclude one or another of the species, and by this process of exclusion it is possible to arrive finally at a reasonable conclusion. It may be safely affirmed that the two species described below are the only ones examined to which these names can consistently be given, without doing violence to some important feature of the original description.

VERNONIA DIVARICATA Sw. Fl. Ind. Occ. 3: 1319. 1806

A straggling shrub, 1–2 m. high; leaves spreading, thin, bright green, elliptical or elliptical-lanceolate, 4–7 cm. long, 1.5–2.5 cm. wide, acute or subacuminate, entire, narrowed to an acute base, minutely puberulent above, thinly pubescent and finely punctate with minute pellucid glands beneath, sessile or with petioles 1–5 mm. long; inflorescence of numerous, lax, loosely flowered, divaricate cymes, bearing each 5–15 secund heads, and frequently prolonged into a leafy shoot; bracteal leaves oblanceolate to narrowly oblong, barely exceeding the 11–13-flowered heads; involucre campanulate, about 4 mm. high; scales thinly strigose-pubescent, the inner oblong, gradually narrowed to a rounded tip, the outer triangular-ovate, obtuse or acute.

The following specimens are referred here: JAMAICA: *Harris 8205*, altitude 500 m.; *Britton & Hollick 1996*, altitude 700 m.; *Britton 431, 679; Cockerell.*

VERNONIA ALBICOMA Gleason, Bull. N. Y. Bot. Gard. 4: 185. 1906

Stem woody, slender; leaves thin, bright green, elliptical or elliptical-lanceolate, 5–6 cm. long, 1.5–2.3 cm. wide, acuminate, subentire, tapering at the base, glabrate above, very finely pubescent or glabrous beneath; petioles 5–7 mm. long; upper leaves somewhat reduced; inflorescence of 1–3 curved spreading terminal cymes bearing each 5–10 sessile secund 18-flowered heads; bracteal leaves lance-oblong, the middle ones about equaling the involucre, which is broadly campanulate or hemispheric, 5 mm. high; scales erect, loosely and irregularly imbricated, nearly glabrous, the outer lanceolate, acuminate, the inner oblong, acute; pappus white.

Campbell 6152, from the foot of Long Mountain, Jamaica, altitude 115 m.

VERNONIA ACUMINATA Less. Linnaea 6: 663. 1831

Shrubby, height not stated; stem finely cinereous-puberulent; leaves thin, bright green, broadly ovate-lanceolate, 6–9 cm. long and half as wide, long-acuminate, entire, acute at the base, very sparsely and minutely puberulent on both sides, on petioles about 5 mm. long; inflorescence of numerous widely spreading freely branched cymes, the ultimate branches bearing 3–7 heads; rameal leaves lanceolate, 2–3 cm. long; bracts oblong-lanceolate to linear, those at the ends of the cymes only 6 mm. long; heads 18-flowered; involucre campanulate, about 5 mm. high, its scales all obtuse or the outer acute, pubescent, especially the outer series, the exposed portion of the inner series oblong.

Wight 20, from wooded hillsides, Port Antonio, Jamaica.

VERNONIA EXPANSA Gleason, Bull. N. Y. Bot. Gard. 4: 186. 1906

A straggling shrub 2.5–3 m. high, branching above; leaves numerous, rather crowded, thin, divaricate, ovate, 3–5 cm. long, 1.7–2.7 cm. wide, acute or subacuminate, entire, obtuse or broadly rounded at base, sparsely and finely pubescent, or nearly glabrous above; petioles 3 mm. long; upper and rameal leaves smaller, broadly elliptical, obtuse; inflorescence of several short cymes bearing each 3–6 heads; bracteal leaves equaling or much shorter than the involucre; heads crowded, sessile, 11-flowered; involucre broadly campanulate, 4 mm. high; scales all appressed, closely imbricated, glabrous or nearly so, rounded at the tip, the outer broadly ovate, the exposed portion of the inner ovate.

JAMAICA: *Harris 8796*, near Troy, altitude 2,000 ft., *Britton & Hollick 1956*, woods, Bluefields Mountain, altitude 750 m.

Vernonia pluvialis sp. nov.

Apparently erect and branched only near the top, height 4 dm. or more; stem finely striate, glabrate, or thinly pubescent, especially above; leaves spreading, or usually ascending, firm and rigid, oblong-ovate to subrhomboid, broadest conspicuously above the middle, the principal ones 3–5 cm. long by 1.1–1.9 cm. wide, acute, entire and subrevolute, gradually narrowed to an obtuse base, minutely puberulent on both sides and glandular-punctate below; veins not prominent, sessile or on petioles 1–2 mm. long; inflorescence of several short few-headed cymes in the axils of the upper leaves, forming a compact leafy panicle; bracteal leaves barely exceeding the heads, ovate to ovate-lanceolate; heads crowded in clusters of 2–7, or sometimes single, sessile, not at all secund, 8- (rarely 5-) flowered; involucre narrowly campanulate or subcylindric, 5–7 mm. high, its scales puberulent, well imbricated in several ranks, the outer ovate-triangular, acute or apiculate, the inner becoming oblong and slightly narrowed to an obtuse or rounded tip; achenes densely hirsute, not mature in the specimens examined; inner pappus pale brown, 4–5 mm. long on the immature achenes.

Type collected by Forrest Shreve on Blue Mountain Peak, Jamaica, May 14, 1906, and deposited in the Herbarium of the New York Botanical Garden. Other sheets in the same herbarium are *Nichols 20*, from moist woods, Morce's Gap, altitude 5,000 feet, *Nichols 120*, from the summit of Blue Mountain Peak, and *E. G. Britton 3856*, from Sir John Peak.

Vernonia proclivis sp. nov.

Shrubby, about 2 m. high; stem sparingly branched, finely striate, glabrate or thinly puberulent; cauline leave sconspicuously reflexed, bright green above, pale green beneath, thin, elliptic-oblong, widest at or near the middle, 6–8 cm. long by 2–3 cm. wide, distinctly acuminate, entire, gradually narrowed or subacuminate at base, glabrous and finely glandular-punctate with transparent globules above and minutely black-punctate beneath; veins prominent beneath; petioles 3–4 mm. long; rameal and bracteal leaves similar, but much smaller; inflorescence cylindrical or pyramidal, composed of numerous short, divaricate, irregularly branched cymes, forming a terminal panicle, and bearing each 4–10 sessile, crowded, 8-flowered heads near their tips; involucre narrowly campanulate, 4–5 mm. high, its scales erect, regularly imbricated in several ranks, thinly puberulent or glabrate, the outer ovate, with acute or apiculate tips, the inner oblong, slightly narrowed to a rounded tip; flowers purple to pale lavender; immature achenes densely pubescent; outer pappus pale brown, 0.4 mm. long, the inner brown, 4 mm. long.

Type, *Britton 102*, from Morce's Gap, near Cinchona, Jamaica, September 2–10, 1906, in the Herbarium of the New York Botanical Garden. Three other sheets in the same herbarium agree with it perfectly and are referred to the same species: *Marble 188*, from Cinchona, *E. G. Britton 3856*, from the Blue Mountains, and *Britton 4055*, from the Parish of St. Thomas. The latter was collected in March; the achenes are all discharged and the dry and brown involucre is widely open.

Vernonia reducta sp. nov.

Shrubby, freely branched above, height not stated; stem striate, glabrate below, becoming puberulent in the inflorescence; leaves spreading, firm, bright green above, paler beneath, narrowly elliptical-oblong or somewhat oblanceolate, broadest at or near the middle, the principal ones 4–4.5 cm. long by 1.2–1.6 cm. wide, sharply acute or subacuminate, entire or finely denticulate, gradually narrowed at the base, minutely puberulent on both sides and finely glandular-punctate beneath; petioles 2–5 mm. long; cymes numerous, terminating the stem and the upper branches, and forming a large loose pyramidal panicle; rameal and bracteal leaves resembling the cauline, but becoming narrower and smaller toward the ends of the branches, and finally barely exceeding the heads; heads crowded in clusters of 2–7, sessile or nearly so, not at all secund, 5-flowered; involucre narrowly campanulate or subcylindric, 5–6 mm. high, its scales puberulent on the back and regularly imbricated in several ranks, outer scales triangular, acute, and somewhat arachnoid-ciliate, the inner becoming oblong-linear, puberulent or glabrate, narrowed to an obtuse apex; achenes about 2 mm. long, hirsute; pappus rufescent, the outer series 0.5 mm., the inner 4–5 mm. long.

Type, *Britton 203*, from Sir John Peak, Jamaica, September

2–10, 1906, in the Herbarium of the New York Botanical Garden. Two other sheets in the same herbarium are *Britton 151*, from New Haven Gap, and *Shreve*, from Sir John Peak.

The seven species of the group may be distinguished by the following key:

A. Heads more or less secund, 11–18-flowered; involucre campanulate to hemispheric, distinctly spreading when press-dried; its scales loosely and irregularly imbricated in few ranks.
- 1. Principal leaves about 3 times as long as broad.
  - *a.* Heads 11–13-flowered; pappus brown. — *Vernonia divaricata.*
  - *b.* Heads 18-flowered; pappus white. — *Vernonia albicoma.*
- 2. Principal leaves twice as long as broad, or less.
  - *a.* Leaves broadly ovate-lanceolate, distinctly acuminate; exposed portion of inner involucral scales oblong; heads 18-flowered; cymes freely branched. — *Vernonia acuminata.*
  - *b.* Leaves broadly ovate, acute or subacuminate; exposed portion of inner involucral scales ovate; heads 11-flowered; cymes sparingly branched. — *Vernonia expansa.*

B. Heads not at all secund, 5–8-flowered; involucre narrowly campanulate or subcylindrical, even when press-dried; its scales rather uniformly imbricated in several ranks.
- 1. Leaves spreading or ascending, nearly or quite sessile, distinctly oblong-obovate or subrhomboidal, 30–50 mm. long, acute; heads 8- (rarely 5-) flowered. — *Vernonia pluvialis.*
- 2. Leaves proportionately narrower or larger, broadest near the middle, more or less acuminate.
  - *a.* Leaves elliptical-oblong, about 25×65 mm., conspicuously reflexed; heads 8-flowered. — *Vernonia proclivis.*
  - *b.* Leaves narrowly elliptical-oblong, about 14×45 mm., spreading; heads 5-flowered. — *Vernonia reducta.*

SPECIES-GROUP FRUTICOSAE

When a sheet of Santo Domingan material came to hand, identified by Dr. Urban as authentic *V. fruticosa* Sw., it was at once seen that the species was entirely distinct from *V. rigida* and from the whole group to which *V. rigida* belongs. It was also seen that its nearest congeners were to be found among some undescribed species from eastern Cuba, with which it is accordingly grouped. As in several other species-groups, the chief similarity between the species included is in the general habit. The most striking common feature here is the broad, rugose or bullate leaf with reticulate venation, closely invested beneath by a dense tomentum. In the Jamaican species-group *Permolles*, with similarly bullate or rugose leaves, the pubescence is densely sericeous-hirsute rather than closely tomentose, and in *V. yunquensis* the character of the involucral scales separates the species at once. The seven species may be distinguished as follows:

I. Santo Domingan species; leaves oblong-ovate, truncate or subcordate at base, obtuse, repand; bracteal leaves not reduced; cymes very flexuous. — *Vernonia fruticosa.*

II. Cuban species.

- *A.* Inner involucral scales obtuse or rounded; leaves ovate-lanceolate. — *Vernonia desiliens.*
- *B.* Inner involucral scales sharply acute or acuminate.
  - 1. Leaves oval to elliptic-oblong, obtuse or narrowed at the base, rugose and finely papillose-pubescent above.
    - *a.* Leaves more than half as broad as long, very blunt or rounded at the apex; straggling plant with white flowers. — *Vernonia calophylla.*
    - *b.* Leaves less than half as broad as long, narrowed to an obtuse or subacute apex; plant erect, with light blue flowers. — *Vernonia vicina.*
  - 2. Leaves of a lanceolate or ovate type, broadest near the truncate or subcordate base, strongly bullate and rugose above.
    - *a.* Leaves acute or barely obtuse, gray-tomentose beneath; inflorescence loose; cymes elongated; inner involucral scales broadest just below the middle. — *Vernonia neglecta.*
    - *b.* Leaves obtuse or rounded; inflorescence compact; cymes abbreviated; inner involucral scales broadest near the base.
      - * Leaves ovate-oblong, crenate or repand, brown-tomentose beneath; involucre densely pubescent; inner scales merely acute. — *Vernonia calida.*
      - ** Leaves broadly ovate or oval, entire or somewhat revolute, closely gray-tomentose beneath; involucre thinly pubescent or glabrate; inner scales sharply acuminate. — *Vernonia semitalis.*

VERNONIA FRUTICOSA (L.) Sw. Fl. Ind. Occ. 3: 1323. 1806.

Stem very slender, freely and loosely branched, glabrous or puberulent in the inflorescence; leaves firm, ovate-oblong, 1–2 cm.

long by half as wide, obtuse or rounded at the tip, irregularly crenulate or subentire, rounded or subcordate at base, dark green and thinly but softly pubescent above, densely gray-tomentose beneath; petioles 1–2 mm. long; upper and terminal branches floriferous and strongly flexuous; bracteal leaves resembling the cauline in shape and size; heads single, sessile, 21-flowered; involucre broadly turbinate or campanulate, 5 mm. high, its scales all erect or somewhat spreading, very loosely imbricated, puberulent or glabrous, the outer subulate, the inner narrowly lanceolate and long-acuminate with a subulate tip; achenes hirsute; pappus nearly white, 4 mm. long.

For the identification of this obscure species of Swartz we are indebted to Dr. Urban. The description above is based on a single sheet, *Fuertes 655*, from the Province of Barahona, Santo Domingo, at 350 m. altitude.

Vernonia desiliens sp. nov.

Herbaceous, sparingly branched, 3–5 dm. tall; stem rather prominently striate, glabrous below, becoming puberulent in and near the inflorescence; leaves firm and coriaceous, ovate-lanceolate to narrowly elliptical, the largest on the type sheet 8–8.5 cm. long and 2.3–2.9 cm. wide, obtuse, entire or obscurely and shallowly crenulate, obtuse or rounded at the base, with petioles 1–3 mm. long, rugose, glabrous and shining above; veins elevated beneath and prominently reticulated, the principal lateral ones strongly ascending and almost parallel to the leaf-margin; the interstices of the reticulations closely gray-tomentose; cymes apparently one or two, terminal and from the upper axils, spreading, 1–2 dm. long, very flexuous; bracteal leaves resembling the cauline but narrower in shape and gradually reduced in size, oblong or narrowly elliptical, 3–5 cm. long, 5–12 mm. wide, spreading, those at the extremity of the cyme oblong-linear, 2 cm. long; heads sessile, single in the axils, 1–2 cm. apart, 21-flowered; corollas purplish; involucre turbinate, thinly pubescent, 9–10 mm. high; the lower outer scales short, minute, triangular, acute and apiculate, and closely imbricated; the inner scales much longer, linear-oblong, obtuse; achenes strigose-pubescent; pappus light brown, the inner series 6 mm. long, minutely barbellate, the outer series 0.5 mm. long, somewhat paler.

Type, *Shafer 3232*, growing among rocks near water, Arroyo del Medio, Oriente, Cuba, at 450–550 m. altitude, January 20, 1910, deposited in the Herbarium of the New York Botanical Garden.

Vernonia calophylla sp. nov.

A straggling shrub, 1 m. high or less; stem slender, striate, freely and loosely branched, cinereous-puberulent below, becoming tomentose in the branches; leaves firm and rigid, ovate to subrotund, the principal ones 20–25 mm. long by 13–18 mm. wide, rounded or obtuse at the apex, entire, somewhat revolute, rounded or subcordate at base, dark green, rugose, and papillose-pubescent above, closely invested beneath with silver-gray tomentum; veins conspicuous, the lateral ones ascending and the veinlets prominently reticulated; petioles 1–2 mm. long; heads in the axils of the upper leaves, forming cymes 10–16 cm. long, sessile, 18–21-flowered; bracteal leaves resembling the cauline, but smaller, 1–1.5 cm. long and more densely pubescent above; corollas white; involucre campanulate, 5 mm. high; scales somewhat arachnoid-puberulent, especially near their tips, the outer ones narrowly triangular, subulate, the inner linear-oblong, acute; achenes pubescent, 2 mm. long; pappus nearly white, the outer series 0.8 mm., the inner 4 mm. long.

Type, *Shafer 8102*, from Camp La Gloria, south of Sierra Moa, Oriente, Cuba, December 24–30, 1910, deposited in the Herbarium of the New York Botanical Garden.

Vernonia vicina sp. nov.

An upright shrub, 3–6 dm. tall, sparingly branched; stem finely striate, glabrate below, puberulent above, and in the branches closely cinereous-tomentulose; leaves firm and rigid, spreading, dark green above, elliptic to elliptic-oblong, the principal ones 3–4.5 cm. long by 1–1.5 cm. wide, broadest at or near the middle, narrowed to an obtuse or subacute tip and to an acute base, entire, somewhat revolute, rugose above, papillose-pubescent when young, becoming glabrate with age, closely invested beneath with thin yellowish brown or cinereous tomentum, especially between the veins; lateral veins ascending, but curved and approximate near the margin; veinlets prominently reticulated; petioles curved, 1–2 mm. long, tomentose; upper leaves like the lower, but smaller, eventually only 1 cm. long by 4 mm. wide, bearing heads in the upper 4–5 axils; heads about 26-flowered; flowers light blue, involucre campanulate, 5–6 mm. high, its scales closely imbricated, glabrous or thinly puberulent, outer scales subulate, somewhat spreading, inner scales lance-oblong, sharply acute; achenes pubescent, 2 mm. long; outer pappus white, 0.8 mm. long; inner series almost white, 4 mm. long.

Type, *Shafer 8202*, from Camp La Gloria, south of Sierra Moa, Oriente, Cuba, December 24–30, 1910, deposited in the Herbarium of the New York Botanical Garden.

Vernonia neglecta nom. nov.

V. Wrightii Griseb. Cat. Pl. Cuba 144. 1866. Not *V. Wrightii* Sch.-Bip. 1863.

Vernonia gnaphaliifolia Gleason, Bull. N. Y. Bot. Gard. 4: 178. 1906. Not *V. gnaphaliifolia* Rich. 1850.

Apparently erect and suffruticose, sparingly branched, 6–15 dm. high; stem and branches slender, obscurely striate, finely gray-tomentulose; leaves firm, flat, spreading, narrowly ovate-oblong to ovate-lanceolate, the largest on the type sheet 6–7 cm. long by 2 cm. wide, acute, or subobtuse and minutely apiculate, entire, rounded, truncate, or even subcordate at base, dark green and bullate above, papillose-puberulent when young, becoming glabrous and shining at maturity, softly gray-tomentose or almost villous beneath, especially along the elevated, prominently reticulated veins; petioles tomentose, 1–4 mm. long; cymes 2 or 3, terminal, spreading, 1.5–2.5 dm. long, straight, leafy; lower bracteal leaves ovate-lanceolate or lanceolate, about 3 cm. long by 1.3 cm. wide; the upper reduced, becoming oblong and only 1.5 cm. long; heads sessile, secund, about 21-flowered, separated by internodes 1–2 cm. long; corollas purple; involucre broadly campanulate, about 6 mm. high, its scales rather closely but irregularly imbricated, thinly pubescent or glabrate, the outer triangular and subulate, the inner ovate-lanceolate, sharply acute, somewhat scarious on the margin; achenes pubescent, 1.5 mm. long; outer pappus white, 0.9 mm. long, the inner series very pale brown or almost white, 4 mm. long.

Type, *Wright 1309*, on banks of cliffs near Monte Verde, eastern Cuba, deposited in the Gray Herbarium of Harvard University. The specimen bears two labels, one dated "Dec. 27," the other "Jan.–Jul. 1859." On the left-hand side of the same sheet is another specimen of the same species, also numbered *1309*, and collected in eastern Cuba, Sept. 1859–Jan. 1860. Another sheet of the same species in the Gray Herbarium is *Wright 2788*.

Vernonia calida sp. nov.

Shrubby, freely branched, 5 dm. tall; stem obscurely striate, thinly puberulent or finely cinereous-tomentulose in the inflorescence; leaves spreading, thick, rigid, ovate-oblong, the principal ones 3.5–5 cm. long and 1.5–2 cm. wide, obtuse or rounded at the tip, crenate or repand, broadly rounded or subcordate at base, strongly bullate, dark green, minutely papillose-pubescent when young, soon becoming glabrate or scabrellate and shining above, densely and softly brown-tomentose beneath; petioles 1–3 mm. long; lateral veins prominent, strongly curved and soon confluent; veinlets prominently reticulated; cymes few, simple or sparingly branched, 6–12 cm. long, the rachis densely tomentose; bracteal leaves resembling the cauline in shape, but smaller, crenulate or entire, the upper 1–1.5 cm. long; heads rather crowded, single or frequently two at each node, about 21-flowered, separated by internodes 1–2 cm. long; corollas pink; involucre broadly campanulate, 7 mm. high; scales densely pubescent, closely imbricated, or somewhat spreading at the tip, the outer subulate, the inner narrowly triangular-lanceolate and acute; achenes pubescent, 1.5 mm. long; pappus yellowish brown, the outer series 0.7 mm., the inner 5 mm. in length.

Type, *Shafer 8408*, in dry soil, Sabanilla to Yamuri Arriba, Oriente, Cuba, January 30, February 1, 1911, deposited in the Herbarium of the New York Botanical Garden.

Vernonia semitalis sp. nov.

Shrubby, 6–9 dm. tall, freely branched above; stem striate, leafy, thinly brown-tomentose, especially on the younger branches; leaves numerous and crowded, thick, rigid, somewhat revolute, divaricately spreading, ovate or ovate-triangular, broadest near the base, 1.5–2 cm. long by 1–1.3 cm. wide, obtuse or rounded at the apex, entire, truncate or subcordate at base; upper surface shining, glabrous or scabrellate, strongly bullate; lower surface closely invested with a thin gray-green tomentum; veins elevated beneath, the lateral ones ascending and confluent near the margin; veinlets prominently reticulated; upper leaves resembling the lower ones and scarcely reduced in size, bearing heads in their axils and forming several crowded cymes 10–15 cm. long; heads about 21-flowered, secund, the lower separated by internodes 1 cm. long, the upper approximate; corollas white; involucre campanulate, about 5–6 mm. high; outer scales triangular-subulate and pubescent, the inner narrowly triangular, sharply acuminate, glabrous or nearly so; achenes pubescent, 1.5 mm. long; pappus nearly white, the outer series 0.7 mm., the inner 4 mm. long.

Type, *Shafer 4176*, from pine land, altitude 400 m., along the trail from Rio Yamaniguey to Camp Toa, Oriente, Cuba, February 22–26, 1910, deposited in the Herbarium of the New York Botanical Garden.

SPECIES-GROUP SAGRAEANAE

This group is distinguished at once from other West Indian species by the large glabrous achenes. The leaves also are usually thick and firm or coriaceous, entire or with spinulose teeth. Most of the species have been in the past poorly represented in American herbaria, and some of them have been seldom collected since their original discovery.

In the revision, *Vernonia rigida* Sw. and *Vernonia fruticosa* (L.) Sw. were regarded as identical and referred to this group, to which the name *Rigidae* was applied. Since that time, specimens of *V. fruticosa* have again been collected, and the species is seen to belong to a different group. The Jamaican *V. rigida*, also, is described with pubescent achenes, a character which removes it at once from this group.

In 1836 De Candolle described *V. Sagraeana* from Cuba, the first known species of the group. This was followed in 1850 by *V. Valenzuelana* of Richard. In 1863 Schultz examined the recent Cuban collections of Wright, and added three species, *leptoclada*, *inaequiserrata* and *Wrightii*, and a fourth, *Sprengeliana*, based on a plant collected by Bertero in Santo Domingo. Grisebach added a variety, *inaequiserrata angustifolia*, also collected by Wright in Cuba. That left the group with seven species and one variety, and, so far as known to the writer, no authentic collection of any of these was made or at least recognized for forty years. Further difficulty was added by the confusion of numbers of some of Wright's collections, so that at least two different species have masqueraded in herbaria under wrong names. One case of this confusion was recognized in 1906 by Gleason, who remedied it by the description of *V. viminalis*.

Since 1906, the collectors of the New York Botanical Garden, in their diligent explorations of Cuba, have recollected four of these old, imperfectly known species, and have added three entirely new forms, which are here described.

The group as a whole is one of the most easily recognized of all the West Indian species. It is characterized especially by a high involucre and by large, glabrous, obscurely ribbed achenes, with a prominent basal callus, and the large, firm or rigid leaves.

I. Species of Santo Domingo; leaves oblong, very tomentose beneath, rugose and scabrous above, narrowly oblong, attenuate from the middle to a truncate or subcordate base; inner involucral scales rounded and apiculate at the tip. *Vernonia Sprengeliana.*

II. Species of Cuba.

- *A.* Leaves thick, coriaceous, more or less revolute and shining above, oblong or ovate-lanceolate, remotely dentate or entire.
  - 1. Heads 8-flowered; involucre cylindric. *Vernonia purpurata.*
  - 2. Heads with 18 flowers or more; involucre campanulate.
    - *a.* Leaves narrowly oblong, at least three times as long as broad, entire, or with numerous minute spinulose teeth. *Vernonia Valenzuelana.*
    - *b.* Leaves broadly oblong, about twice as long as broad, entire, or with a few few remote but conspicuous teeth.
      - * Scales of the involucre all erect or barely spreading, the inner acute, the outer mucronate. *Vernonia leptoclada.*
      - ** Outer scales conspicuously squarrose or reflexed, all sharply acuminate or subulate. *Vernonia Wrightii.*
- *B.* Leaves thin or firm, but not coriaceous, flat, serrate, spinulose-denticulate, or entire.
  - 1. Leaves puberulent or glabrous beneath.
    - *a.* Outer scales of the involucre short, acute or mucronulate, appressed. *Vernonia Sagraeana.*
    - *b.* Outer scales of the involucre elongated, subulate, spreading. *Vernonia aronifolia.*
  - 2. Leaves tomentose beneath.
    - *a.* Middle involucral scales sharply acuminate, densely ciliate. *Vernonia viminalis.*
    - *b.* Middle involucral scales rounded to a mucronate apex, or acute.
      - * Inner scales obtuse or subacute; middle scales without scarious margin; leaves entire or obscurely spinulose-denticulate. *Vernonia fallax.*
      - ** Inner scales apiculate; the middle with a scarious margin.
        - ° Leaves narrowly linear-oblong, entire. *Vernonia aceratoides.*
        - °° Leaves narrowly elliptic-oblong, sharply serrate. *Vernonia inaequiserrata.*

Vernonia Sprengeliana Sch.-Bip. The type specimen cited by Schultz is *Bertero 507* and the recent description by Gleason is based on a single sheet of *Wright, Parry, & Brummel 273*. An excellent collection of this rare species, *Fuertes 1388*, has been recently distributed and agrees perfectly with the original description and with that of Gleason (Revision, 184).

Vernonia purpurata sp. nov.

Shrubby, 2–2.5 m. tall; stem stout, coarsely striate, thinly tomentose below, becoming densely so in the inflorescence; leaves crowded, heavy, rigid, coriaceous, divaricate, elliptic-oblong, obtuse or subacute, entire or irregularly repand, obtuse or rounded at base, strongly rugose above, but glabrous and shining except for some thin pubescence along the midvein, minutely puberulent along the veins beneath; veins elevated on the lower surface, the lateral veins prominent, ascending, the veinlets small and closely reticulated; petiole 2–4 mm. long, tomentose; inflorescence small, irregular, composed of several short (2–6 cm.) leafy cymes, bearing each 4–10 heads; rameal leaves resembling the cauline, but two thirds as long; bracteal leaves narrowly oblong or oblong-linear, 10–15 mm. long, not present below many of the heads; heads sessile, secund along the cymes or aggregated at their tips, 8-flowered; corollas white; involucre narrowly cylindric, 6 mm. high; scales closely imbricated, appressed, sharply acute, the lower ovate-triangular, pubescent, the middle ones with an ovate-triangular exposed portion, ciliate, glabrous on the back, the inner entire, puberulent on the back, purple-brown at their exposed tips; achenes glabrous, immature in the type specimen; pappus pale yellow-brown, the outer series 1.3 mm., the inner 7 mm. long.

Type, *Taylor 544*, from Jiquarito Mountain, Sierra Maestro, eastern Cuba, altitude 1,020 m., September 18, 1906, deposited in the Herbarium of the New York Botanical Garden.

The lower leaves are lacking from the type plant. The crowded upper leaves are remarkably uniform in size, 4–5 cm. long by 1.5–1.9 mm. wide. On another branch is the base of a leaf which measures 3 cm. wide, indicating that the lower leaves are considerably larger than the upper. While the species certainly belongs to this group, it is distinguished from all the others known by its few-flowered heads.

Vernonia Valenzuelana Rich. A shrub 1.2 m. high, on dry ferruginous soil, southeast of Paso Estancia, Oriente, Cuba, *Shafer 1705*.

Vernonia leptoclada Sch.-Bip. A specimen agreeing perfectly with the original description has been recently collected by Shafer, *8145*, from Camp La Gloria, south of Sierra Moa, Oriente, Cuba. It is described as a straggling shrub 3.5 m. tall, with white flowers.

Vernonia Wrightii Sch.-Bip. *Ex descr.* A shrub, 1 m. high, freely branched above; stems pubescent; leaves heavy and coriaceous, spreading or ascending, ovate-oblong to oblong, 3.5 cm. long by 1.2 cm. wide, sharply acute or mucronate, revolute, entire or with a few remote spinose teeth, rounded or even subcordate at the base, very scabrous above but not pubescent, minutely puberulent under the lens beneath; petioles 1–2 mm. long, pubescent; cymes long and spreading, with numerous heads; bracteal leaves like the cauline, but gradually reduced to 1 cm. long; heads sessile, secund, about 21-flowered; involucre about 7–8 mm. high, outer scales ovate, acuminate into a squarrose or recurved tip, the inner erect or somewhat spreading, sharply acute or subulate; pappus pale brown.

Shafer 7738, from a dry serpentine hill near El Yunque, Oriente, and *Shafer 3072*, from pine lands at 500–650 m. altitude near Woodfred, Oriente, are referred here. They agree in most essential points with Schultz' description of *V. Wrightii* (Journ. Bot. **1**: 234. 1863), but lack the glabrous leaves narrowed at both ends and the sordid-purple pappus.

Schultz' species is based on *Wright 1309*. As is well known, the Wright numbers are much confused, and frequently shelter more than one species. The only available specimen of this number belongs to an entirely different species.

Vernonia Sagraeana DC. A shrub 1.5 m. tall, growing on banks at an altitude of 325 m., near El Cuero, Oriente, *Britton & Cowell 12794*.

Vernonia aronifolia sp. nov.

Bushy, suffrutescent or shrubby, 12–15 dm. high; stem stout, freely branched, striate, finely and thinly tomentose, the tomentum increasing in density toward the tips of the branches and always most abundant in the axils; leaves dark green, thin but firm, obovate-oblong, about 8 cm. long by 4 cm. wide, abruptly acuminate, remotely denticulate with subulate or spinulose teeth 0.5

mm. long, standing at right angles to the margin, obtuse or subacute at base, minutely puberulent beneath, especially along the veins, glabrous above; veins prominent, light green, the lateral ones arcuate-ascending, branched and reticulated, especially toward the margin, one of the smaller marginal veins prolonged into each denticulation; cymes terminal and lateral, spreading, unbranched, 15–20 cm. long, very leafy, bearing 6–10 heads; bracteal leaves resembling the cauline in shape and texture, or varying to broadly oblong-elliptic in shape; the lower approximating the cauline in size, the upper gradually reduced to half the size, but always greatly exceeding the flowers; heads sessile, single in the axils, about 34–47-flowered; corollas white; involucre hemispherical or broadly campanulate, 8–9 mm. high, in dried specimens about 15 mm. broad; scales thinly puberulent, imbricated only at the base, straight or erect in bud, becoming spreading or flexed in fruit, the outer lance-linear, subulate, the inner linear-oblong, acuminate to a subulate tip; achenes smooth; outer pappus white, 0.8 mm. long, inner series pale brown or nearly white, 8 mm. long, minutely barbellate.

Type, *Shafer 13514*, collected from high rocks in limestone hills, vicinity of Sumidero, Province of Pinar del Rio, Cuba, August 2, 4, 1912, deposited in the Herbarium of the New York Botanical Garden. The collection is represented by two sheets, one including apparently the top of the plant, and the other two detached lateral branches.

Vernonia fallax sp. nov.

Shrubby, 1 m. high; stem erect, sparingly branched, finely striate, closely gray-tomentose, especially above; leaves firm, bright green above, elliptic-oblong, 5–7 cm. long by 2–2.5 cm. wide, acute, mucronate, entire or very obscurely and remotely spinulose-denticulate, narrowed to an acute base, thinly puberulent above, especially on the veins, finely and closely gray-tomentose beneath; veins elevated and prominent beneath, not conspicuously reticulated; petioles 1–2 mm. long; inflorescence pyramidal, terminal, of about 4–10 short, spreading or recurved cymes bearing each 3–7 heads; heads secund, sessile, about 21-flowered; involucre broadly campanulate or subhemispherical, 6–7 mm. high, its scales appressed, closely imbricated, pubescent, especially near the tip, outer scales ovate-triangular, acute and cuspidate, the inner subacute or rounded at the tip; outer pappus white, 0.7 mm. long, the inner pappus very pale brown, 6 mm. long; achenes glabrous.

Type, *Britton & Wilson 5478*, from a hillside, altitude 500 m., in the Trinidad Mountains, Province of Santa Clara, Cuba, March 12, 1910, deposited in the Herbarium of the New York Botanical Garden.

The bracteal leaves have all fallen off the type specimen, except a few fragments, and the leaves are crowded on short lateral branches. The inflorescence is thus left at the end of a naked peduncle 2–3 dm. long, giving the specimen an aspect entirely unlike other species of the group. It is scarcely to be expected that the same peculiarity will be maintained in other collections of the species.

Vernonia aceratoides sp. nov.

Vernonia inaequiserrata angustifolia Griseb. Cat. Pl. Cuba 144. 1866.

Slender and probably herbaceous; stem finely striate, closely gray-tomentulose; leaves firm, spreading or ascending, narrowly oblong-lanceolate or lance-linear, the principal ones 7–8 cm. long and 1–1.2 cm. wide, acute and mucronulate at the tip, entire or somewhat repand; obtuse or rounded at the base, minutely scabrellate above and puberulent along the midvein, finely brown-tomentulose beneath; veins prominent beneath and conspicuously reticulated; petioles 2–3 mm. long; inflorescence terminal, of about 3 short divaricately spreading cymes, bearing each six or seven secund heads; bracteal leaves oblong, the upper ones not exceeding the heads, and all proportionately broader than the cauline; involucre narrowly campanulate, 5–6 mm. high; scales closely and regularly imbricated, appressed, the outer ovate-triangular, cuspidate, the inner with an ovate exposed portion, rounded and apiculate at the tip.

Grisebach's variety was based on a specimen of *Wright 2784;* the preceding more detailed description is based on a sheet of the same number in the Herbarium of the Missouri Botanical Garden.

Species-group Longifoliae

The herbarium of Dr. Otto Kuntze contained a good specimen of a *Vernonia* from St. Thomas, collected by Kuntze himself in 1874, and labeled *Vernonia Thomae* Benth. It can not be distinguished, however, in any essential character from *Vernonia albicaulis* Pers., and the two species may henceforth be considered identical. This disposition of *V. Thomae* was suggested before by Gleason (Revision, 191), although at that time the two were kept separate since good material for examination was lacking. The island of St. Thomas is accordingly added to the known distribution of *V. albicaulis.* It has been collected in St. Thomas by others also, and is represented in the herbarium of the Field Museum by two sheets, *Millspaugh 522* and *Eggers 34.*

Vernonia longifolia Pers. To the distribution of this species may be added St. Martin, *Boldingh 2641*, and Montserrat, *Shafer 172, 589, 659, 661.*

Lepidaploa, *Scorpioideae reductae*

Vernonia arctata Gleason. The species was originally described (Bull. Torrey Club 33: 185. 1906) from New Providence Island, of the Bahama group, but is now known to occur also throughout Andros Island, *Small & Carter 8506, 8613, 8759, 8890, Brace 5176, 6754, 6926, 7138.* Field data show that the flowers vary from purplish white to bright rose-purple and that the plant reaches a height of 2 meters.

Vernonia bahamensis Griseb. Reported by Gleason (Bull. Torrey Club 33: 187. 1906) from Fortune Island and Inagua, it is now represented also by specimens from Crooked Island, *Brace 4851;* Acklin's Island, *Brace 4330;* Salt Cay, *Millspaugh & Millspaugh 9249;* Long Cay, *Brace 4152, 4020, 4115;* Mariguana, *Wilson 7461;* Castle Island, *Wilson 7783;* Cotton Cay, *Millspaugh & Millspaugh 9362;* North Caicos, *Wilson 7721, Millspaugh & Millspaugh 9175;* East Caicos, *Millspaugh & Millspaugh 9082;* and South Caicos, *Wilson 7688.* The last specimen cited has leaves subacuminate or merely acute at the base, 5 cm. long by 2.5 cm. wide, and in general closely approximates *V. albicaulis* Pers. The *Scorpioideae reductae* have been considered (Gleason, Revision, 165, 166) as related by origin to the species-group *Longifoliae,* to which *V. albicaulis* belongs, and the theory is strengthened by the strong superficial resemblance just mentioned. It is interesting to note that *V. bahamensis* occupies the southeastern portion of the Bahama archipelago, nearest the area of the *Longifoliae,* and that the particular specimen comes from South Caicos, which is almost the extreme southeastern island of the group.

Vernonia complicata Griseb. In the type collection, *Wright 2790,* the leaves are all entire, subrotund, and about 5 mm. long.

An excellent specimen, *Britton 2225*, recently received at the New York Botanical Garden from Guantanamo Bay, in extreme eastern Cuba, has leaves of the same character on the old shoots, while on the young branches they are flat or undulate and 10–15 mm. long. The Guantanamo plant is described as a shrub 1 m. tall with purple flowers.

Lepidapioa, *Scorpioideae aggregatae*

Vernonia Thomae Benth., included here by Gleason (Revision, 191), is now regarded as identical with *Vernonia albicaulis* Pers. Urban (Symb. Antill. 7: 421. 1912) has recently added a species, so that the number in the group remains four. They may be distinguished as follows:

A. Achenes pubescent; outer pappus conspicuous, its scales much broader than the white bristles of the inner series; leaves 2–3 cm. long. *Vernonia buxifolia* (Cass.) Less.

B. Achenes glabrous and glandular; outer pappus minute, its scales not sharply distinguished in width from those of the inner series.

1. Leaves tomentulose beneath; pappus strongly tinged with rose color; heads about 11-flowered. *Vernonia Tuerckheimii* Urban.
2. Leaves minutely puberulent or glabrous beneath; pappus yellowish or tawny; heads 8-flowered. *Vernonia montana* Gleason.

C. Achenes densely hirsute; outer pappus conspicuous, its scales chaffy and fimbriate; leaves 4–5 cm. long, closely gray-tomentose, and with prominent veins beneath. *Vernonia yunquensis* Gleason.

The first three species are all very similar in habit and structure, and are all natives of Hispaniola. There is no doubt that they are closely related. The character of the pappus and the larger leaves indicate that *V. buxifolia* is the primitive form. The distribution (Cuba) and the general habit of *V. yunquensis*, especially of the leaves, as expressed in pubescence and venation, separate it sharply from the first three species, and imply that it may logically constitute another species-group.

Vernonia segregata sp. nov.

A straggling or vinelike shrub, reaching a height of 2.5 m.; stem obscurely striate, closely pubescent; the branches olive-brown and finely tomentulose; leaves numerous, crowded, firm, dark green, oblong to elliptic-obovate, broadest at or above the middle, the principal ones 2.5–4 cm. long and 1–1.5 cm. wide, obtuse or subacute, entire, obtuse or rounded at the base, scabrellate and resinous-punctate above, glabrous beneath and densely punctate with resinous globules and impressed black glands; midvein puberulent, the lateral veins inconspicuous; petioles 1–2 mm. long; inflorescence terminal, irregular in shape, consisting of several short, simple or sparingly branched cymes 2–4 cm. long, naked below, and bearing 2–8 crowded heads in a terminal subcapitate cluster, or at the base of the branches; bracteal leaves 1–3 subtending each cluster of heads, resembling the cauline in shape, 5–15 mm. long; heads about 8-flowered; corollas white; involucre campanulate, 3–4 mm. high, its scales loosely and irregularly imbricated, appressed at the base, but spreading at the tip, stiff and firm in texture, the outer narrowly triangular-lanceolate, long-acuminate, the inner narrowly oblong-linear, tapering gradually to the acuminate puberulent apex; achenes thinly pubescent, 2 mm. long; pappus nearly white, the outer series 1 mm., the inner 4 mm. long.

Type, *Shafer 4050*, from rocky river banks in the vicinity of Camp San Benito, Oriente, Cuba, altitude 900 m., February 24, 1910, deposited in the Herbarium of the New York Botanical Garden. Other sheets in the same herbarium, all collected in the mountains of Oriente, are *Shafer 8051*, stated to be vinelike and 8 feet high; *Shafer 8216*, 1.5–2 feet high; and *Shafer 4446*, described by the collector as an herb three feet high with purple flowers. Notwithstanding field differences in the color of flowers or texture of stem, all four numbers clearly belong to the same species.

The relationship of *V. segregata* is puzzling. The subcapitate clusters clearly represent a modification of a scorpioid type, and most closely resemble the inflorescence of the *Scorpioideae aggregatae*. The involucre is quite different, however, from that of typical members of the group. For the present, it has been considered advisable not to assign the species to any group.

SPECIES-GROUP HAVANENSES

In recent work on *Vernonia*, *V. havanensis* and *V. Ottonis* have been considered identical (Revision, 192). The large series of specimens now available for study permits the ready separation of two species, with characters so typical that to each can be assigned the proper specific name without difficulty. In addition, a new species has been collected by Shafer and is described below.

With the exception of *V. pallescens*, whose position in this group is somewhat uncertain, the group is distinguished by similarities in habit. The leaves are of a comparatively broad type, widest near or usually above the middle, and with the serration most prominent on the distal half. The involucre scales are regularly pubescent in two areas on the back, one on each side of the mid-nerve.

The four species may be distinguished as follows:

A. Inflorescence strictly scorpioid; the cymes many-headed and elongated; heads all sessile. — *Vernonia pallescens.*

B. Inflorescence freely branched and subpaniculate, some of the heads pedicellate; leaves with a tendency to be broadest above the middle; scales glandular on the back, especially on each side of the mid-nerve.

1. Heads with 18 flowers or more; involucres 5–8 mm. high, or some of the scales 10 mm. long, distinctly purple-tinged; leaves essentially glabrous on both sides; pappus white, or with a faint brownish yellow tinge. — *Vernonia havanensis.*
2. Heads 5–13-flowered; involucres 3–4 mm. high, obscurely or not at all tinged with purple; leaves scabrous above; pappus pale brown.
   - *a*. Heads 11–13-flowered; inner scales obtuse or subacute; inflorescence divaricate. — *Vernonia Ottonis.*
   - *b*. Heads 5-flowered, aggregated in subcapitate clusters at the ends of the branches, forming a pyramidal or subhemispheric inflorescence; inner scales acute. — *Vernonia Orientis.*

Vernonia pallescens Gleason. The species certainly differs phylogenetically from the rest of the group, as shown by its inflorescence and its geographical distribution. It is included in the group merely for lack of a better place to put it.

VERNONIA HAVANENSIS DC. Prodr. 5: 37. 1836.

Vernonia stictophylla Wright, Sauv. Anal. Acad. Ci. Habana **6**: 176. 1869.

The specimens at hand fall into two groups, the first with leaves long-attenuate at base, almost sessile, and thin in texture; the second with leaves cuneate into a distinct petiole and firm in texture. No other characters for their separation have been found. The first group includes the type collection for Wright's species. Both series have been collected, so far as data are given, in the province of Pinar del Rio.

VERNONIA OTTONIS Sch.-Bip. Linnaea **20**: 508. 1847.

Vernonia hieracioides Griseb. Mem. Am. Acad. **8**: 511. 1860.
Vernonia cubensis Griseb. Cat. Pl. Cuba 144. 1866.

Except one collection from Santa Clara (*Leon 1315*) and one from the Isle of Pines (Curtiss), all the sheets examined are from Pinar del Rio. They show considerable variation in the pubescence, serration, and texture of the leaves, but can not be further separated. The specimens include cotypes of both Grisebach's species, and agree perfectly with Schultz' description.

Vernonia orientis sp. nov.

Shrubby, as much as 6 m. in height, apparently not extensively branched; stem coarsely striate, glabrate below, becoming cinereous-puberulent in the inflorescence; leaves rigid, dark green, spreading, oblanceolate, the principal ones 9–11 cm. long by 2.5–3.5 cm. wide, abruptly short-acuminate or sharply acute, remotely dentate with sharp salient teeth, chiefly above the middle, attenuate from below the middle to a cuneate base, very scabrous above, minutely puberulent and scabrellate beneath; veins elevated below, only the midvein and its lateral branches prominent; petioles 5–10 mm. long; inflorescence terminal, broadly pyramidal or subhemispheric; cymes freely branching, ultimately bearing 2–6 heads aggregated or subcapitate near the tips; bracts subulate, 3–5 mm. long; heads 5-flowered; involucre 3–4 mm. high, campanulate; scales ovate to ovate-oblong, sharply acute or subacuminate, essentially glabrous but glandular on the back; achenes sparingly pubescent; outer pappus minute, the inner pale yellowish brown, 4 mm. long.

Type, *Shafer 3509*, from Sierra Nipe, near Woodfred, Oriente, Cuba, altitude 450–550 m., January 10, 1910, deposited in the Herbarium of the New York Botanical Garden.

The two collections, both from Oriente, are the only examples of the group from this part of the island. It is distinguished from the other members of the group at a glance by its inflorescence, and also by the involucral scales and the number of flowers.

Lepidaploa, *Paniculatae dichotomae*

VERNONIA MENTHAEFOLIA (Pöpp.) Less. Linnaea 4: 268. 1829.
Eupatorium menthaefolium Pöpp. in Spreng. Syst. 3: 412. 1826.
Vernonia Grisebachii Sch.-Bip. Jour. Bot. 1: 231. 1863.

The original description of this species by Pöppig is too brief to be of any value at the present time. But his specimens were preserved, and examined later by both Schultz and Lessing. Lessing gives a detailed description, based on these types, stating that the heads are many-flowered and 3 lines high. Schultz' description, referring without doubt to the same specimens, or to duplicates of them, indicates that the heads are 11-flowered and the involucre hardly 1 line high. He then described *V. Grisebachii*, as cited above, to include the forms with large heads, based on *Wright 1305*. Examination of an ample series of specimens at the present time reveals but one species, agreeing with Lessing's and Schultz' descriptions, but never with the small heads ascribed by the latter to *V. menthaefolia*. In the series examined are two of Wright's collections, *282* and *2792*, and *Shafer 8811*, which was found by Dr. Britton to agree with the specimen of *Wright 1305* in the Kew herbarium. Throughout the series the heads have 11 to 18 flowers, and the involucres are 4–5 mm. high. The leaves show considerable variation, from narrowly oblong-lanceolate, acuminate at both ends, to ovate, rounded at the base and acute at the apex. These characters are not sufficiently definite or constant to permit the recognition of two species.

V. menthaefolia is the most abundant species of the genus in Cuba, judged from the frequency of its collection, and occurs throughout the island.

Among recent accession to the Herbarium of the New York Botanical Garden is an *Eremosis* from the state of Durango, which differs distinctly from all the fifteen described species of the genus.

Eremosis ovata sp. nov.

Shrubby; height and habit not stated; stem obscurely striate, closely cinereous-pubescent, becoming tomentulose in the inflorescence; leaves thick, firm, ovate to ovate-elliptic, 7–10 cm. long, 4–5 cm. wide, obtuse or subacute, entire, obtuse at base, dull green, minutely and softly tomentulose above, densely cinereous-tomentose beneath; veins elevated below, the lateral ones prominent and ascending, the veinlets inconspicuous; petiole 8–13 mm. long; inflorescence broadly pyramidal or hemispheric, about 2 dm. wide; rameal leaves elliptic, about 2–6 cm. long, otherwise like the cauline; heads 4-flowered, in clusters of 3–8, on pedicels 2–5 mm. long; involucre narrowly campanulate, straw-colored or pale brown, 5–6 mm. high, outer scales short, broadly ovate, obtuse to subacute and apiculate, irregularly arachnoid or tomentulose, inner scales deciduous, oblong or ovate-oblong, acute, glabrous, or with minute patches of thin tomentum near the tip; achenes pale brown, 3 mm. long, prominently ribbed, thinly hirsute with ascending hairs; pappus white, 8 mm. long, the outer series much shorter.

Type, *Palmer 139*, from San Ramon, Durango, Mexico, deposited in the Herbarium of the New York Botanical Garden.

In general habit and shape of leaf, *Eremosis ovata* most closely resembles *Eremosis Steetzii* (Sch.-Bip.) Gleason, but is distinguished at once from this one-flowered species by its four-flowered heads. Its nearest relatives are probably to be found among the three-flowered species, such as *Eremosis Palmeri* (Rose) Gleason, from which it differs in the broad ovate leaves and dense tomentum.

The presence regularly of four flowers in each head is a peculiar feature, hitherto unknown in the genus. It is paralleled in a way, however, by the occurrence of two flowers instead of one in the heads of certain specimens of *Eremosis tarchonanthifolia* (DC.) Gleason.

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A. B. STOUT

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A. B. STOUT

(WITH PLATE 20)

The precise nature of bud-variation is not satisfactorily known. No adequate classification of the various kinds of bud-variation has been made. Recent investigations regarding the nature of plant chimeras indicate that some of the phenomena generally considered as bud-variation are associated with chimeras and are to be explained by the nature of the chimeras. Observations and experiments are now being made at the New York Botanical Garden on various types of bud-variation. In the studies on *Pelargonium* one case has arisen which seems of special interest in its bearing on the nature of bud-sports from plants that are chimeras.

Baur (1909 *a* and *b*; 1911) has recently shown that the variegation in the case of the "albomarginatae" varieties of *Pelargonium zonale* is due to the presence of white and green cells which are sharply distinct and which occupy a characteristic position in relation to each other. It has been long known that the paler tissue of these variegated plants owes its characteristics to a lack of chlorophyl in its cells. Baur shows that the plastids are present in the white cells but are colorless.

Baur further claims that this arrangement of green and white cells in the leaf can be explained by the arrangement of the corresponding tissues in the growing point and actually shows that in the plants whose leaves have layers of white cells on the exterior there is in the apex of the stem a cap of white cells over the greener cells beneath. In such plants the relative position of the white and the green cells is maintained throughout the development of the leaves.

By further study Baur (1909 *a*; 1911) found that in other cases these two kinds of cells may be variously arranged with reference to each other. In some plants various stems and leaves show a sectoral arrangement with a more or less bilateral distribution of the two kinds of cells. In certain types of *Pelargonium* the green cells are outside as one or two layers covering the white cells. In some individuals streaks of one of the tissues are mingled with the other.

Baur is able to interpret the conditions in these various forms by using the conception developed by Winkler (1907) in his remarkable discoveries regarding the so-called chimera-nature of graft hybrids. Baur introduced the term *periclinal chimera* for the condition where the peripheral cell-layers are different from the enclosed tissues and *sectoral chimera* for the cases where there is more or less of a bilateral or radial distribution. The term *hyperchimera*, first suggested by Strasburger (1909), is used for the cases where there is a more or less intimate mixture of the different kinds of cells.

On these various chimeras of *Pelargonium*, wholly green or wholly white shoots may arise. This is due to the fact that the two kinds of cells which are maintained by the cell divisions in the meristematic regions become segregated in the growing points, the process not being essentially different from that by which peripheral, sectoral, or hyperchimeras arise.

The various types of these *Pelargonium* chimeras are familiar to horticulturists and have been propagated rather widely by cuttings, thus preserving quite uniformly the different forms. The periclinal chimeras having white peripheral cell layers are commonly cultivated forms on account of the striking effect of the white-margined leaves.

One of these varieties is known by the trade name of *Madame Salleroi*. During the summer of 1912 a plant of this type which was grown in an outdoor bed at the propagating houses of the New York Botanical Garden produced a branch in which the relative position of the two kinds of cells is reversed. When the cutting was made during the early part of the summer it possessed only leaves with the white margin. In October of that year, when first brought to the attention of the writer, the plant appeared as shown in the photograph here reproduced (see PLATE 20). Two branches, one the main and the other a lateral branch, bore leaves with the white cell layers placed externally to the green as was the case in the plant from which the cutting was made. The leaves were quite uniform in shape and in coloration and are quite typical for the variety known as *Madame Salleroi*. Dr. L. H. Bailey kindly made the varietal determination from leaves taken from these branches and further states in a letter to the writer that this variety has not been thus far placed specifically. As shown in PLATE 20, the enclosed green cells fail to develop uniformly toward the margin of the leaves, thereby leaving an irregular marginal zone of pure white cells. In the central portion of these leaves the enclosed green tissues show through the white.

On the third branch, which is a lateral one, the leaves are quite different. They are larger and the surface is green to the extreme margin. These leaves are not, however, of a uniform green, for through the central portion of each there is an irregular palmate-shaped area of lighter green which is due to white cell-layers enclosed between the upper and the lower green layers. In other words the place relationship of the white and the green cells is here reversed from what it is in the main part of the plant. In this branch the plant has literally turned itself inside out. Microscopical examination of free-hand sections confirmed the superficial observations as to the color relations.

In the black and white plate accompanying this article the general pattern in the leaves is well shown by the different shades. Since this plant has been under observation, about twenty leaves have matured on this branch. As shown in PLATE 20 the amount and distribution of the white tissue varies in the different leaves. In some leaves there are small flecks of white scattered through the green. A few of the leaves when about half developed show traces of a dark zonal band which is a feature of various showy-leaved Pelargoniums. When these leaves are mature, however, this zonal band is faint.

Baur notes a case of bud-variation identical with this one. He states (1909 *a*, p. 333), that the plant which he designated as Pel. 9 had white-bordered leaves but produced in 1908 a branch having wholly green leaves but which were plainly of a yellowish green in the center. The anatomical studies of these leaves (1909 *a*, p. 345) showed that the white cells were enclosed by the green cells.

In the light of Baur's anatomical studies this sort of bud-variation is readily understood as due to a mechanical readjustment of the two kinds of cells already in the growing points. This particular type involves more extensive rearrangement than the cases where pure green or pure white branches are produced by the development of a bud containing only one kind of cells to the exclusion of the other. For the development of a branch reversing the position of the two kinds of cells as described above there must be a breaking out of the enclosed green cells in the growing point and a growth of both green and white cells in such a manner that the green cells surround the white cells. It may be that in this case the green cells break forth at two separate points not far distant and that in further growth they meet, enclosing the white cells.

On the main portion of the plant here shown, the mature leaves possess over their whole surfaces two peripheral cell-layers that are white. To maintain this relationship the cell divisions which give rise to these layers must occur only in planes which are at right angles to the surface of the leaf. The outer layers do not contribute to the vascular tissues and the inner green tissue does not form epidermis, a fact clearly shown by Baur. In the sporting branch, however, the green cells get to the surface and form the epidermis as well as some of the mesophyl and vascular tissue, while the white cells cease to form epidermis and now contribute only to the inner tissues. The cells preserve the green and white character of their chromatophores but take on different structures or different functions according to position and environment.

In his interesting report of results of anatomical and hereditary studies of variegated varieties of *Pelargonium*, Baur was not especially concerned with the evidence of interaction between the two kinds of cells, the white and the green, where both exist in the same leaf. His photographs, however, show the same sort of difference which have appeared so strikingly in the case here under consideration.

The marked differences between the two kinds of leaves produced on this plant (PLATE 20) make it clear that the outer layers largely determine the size of the leaves and the depth of the lobing. When the green is outside the leaf is larger, more deeply lobed and like those which are borne on the branches that are composed purely of green tissue. When the white is outside, the leaf is much smaller and more like those leaves which are composed only of white tissue. Several plants of *Pelargonium Madame Salleroi* of the same clone as the plant producing this bud-variation have been under observation in the propagating houses. Several of these have produced leaves composed wholly of white cells. These have been of practically the same shape and size as the variegated leaves on the same plant. The pure white cells are, of course, dependent upon the green cells for carbohydrate food. In the case of a chimera relationship with the green cells enclosed, there may be mechanical and chemical stimuli to the overlying white cells that result in a slightly larger leaf. This effect is, however, not marked.

All the potentialities of a large and deeply lobed leaf are present in the green cells of a typical leaf of the *Madame Salleroi* variety. When these green cells get to the exterior those potentialities find expression, but as long as the peripheral layers of white are uniformly maintained, there is no visible evidence that these potentialities exist. Their suppression may be due chiefly to mechanical limitations imposed by the peripheral layers of white cells which decrease the number of cell divisions.

In the various plant chimeras there is an association of more or less independent and different kinds of cells. In the chimeras resulting from grafting, the two kinds of cells may be decidedly different, producing, when separate, two distinct types of leaves, but when associated together, forming leaves of still different patterns. The various chimeras produced by Winkler (1907 and 1909) and the chimera *Crataegomespilus Asnieresii* (see illustration by Baur 1911, *pl. VIII*) illustrate this phenomenon. In addition to such mechanical and physical interactions, Winkler (1910) has presented some evidence that there may be a vegetative fusion of cells in graft tissues producing what he would consider as the only true graft-hybrid, and he further holds that hybrid modifications may also result from the migration of such substances as atropin or nicotine between stock and scion.

These facts indicate that the general phenomena of plant chimeras have a very direct bearing on theories of morphogenesis and that cellular interaction is a potent factor in influencing cell differentiation and in determining the physical characteristics of such organs as leaves.

The bud-sports which arise from the various *Pelargonium* chimeras are, we may say, rather simple cases of variation due to a mechanical rearrangement of the kinds of cells already present. Their appearance is a confirmation of the rule that like produces like in its application to cell lineage rather than evidence of spontaneous somatic mutation or variation. In this case the real variation occurs when the white cells appear as the progeny of green cells. The frequency of this spontaneous variation in *Pelargonium* (and in other cases as well) and the real nature and the causes of the process are problems for future solution.

NEW YORK BOTANICAL GARDEN.

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PER AXEL RYDBERG

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Studies on the Rocky Mountain flora — XXIX

Per Axel Rydberg

MONOTROPACEAE

Hypopitys latisquama Rydb. sp. nov.

Plant pink, 1–3 dm. high, more or less short-pubescent above; scales of the stem broadly ovate, obtuse, 1–1.5 cm. long; flowers usually 10–15; sepals spatulate or cuneate, 8–10 mm. long, abruptly acuminate, ciliate; petals cunate or obovate, 11–12 mm. long, rounded and sinuate at the apex, pubescent and ciliate, filaments and style copiously hairy; stigma retrorsely bearded.

This is closely related to *H. lanulosa* (Michx.) Nutt., but differs in the large and broad scales on the stem and the larger flowers.

Montana: Bridger Mountains, July 28, 1896. *Flodman 708* (type, in herb. N. Y. Bot. Gard.).

Wyoming: 1873, *Parry 196*.

Washington: Olympic Mountains, *Elmer 2464*.

PRIMULACEAE

Primula specuicola Rydb. sp. nov.

Perennial with a short rootstock; leaves 5–13 cm. long, thin, slightly farinose when young, in age glabrate, with winged petioles; blades spatulate or elliptic, obtuse at the apex, sinuate-dentate; scape 1–1.5 cm. long; umbels 10–20-flowered; bracts linear-subulate, thin, 5–10 mm. long, slightly gibbous at the base; pedicels 5–10 mm. long in flower or 1–4 cm. long in fruit; calyx densely farinose; tube deeply campanulate, 3–5 mm. long; lobes linear-oblong, 2.5–3.5 mm. long, obtusish; corolla-tube yellowish, 8–10 mm. long, 1.5 mm. in diameter; lobes cuneate, merely emarginate with a broad sinus, dark violet, about 3 mm. long; stamens inserted in the middle of the corolla-tube; capsule about 6 mm. long.

This species is related to *P. farinosa* L. and *P. incana* M. E. Jones, but differs from both in its very thin leaves, more exserted corolla-tube and slender bracts. In *P. incana* M. E. Jones (*P. americana* Rydb.), the only other species of the group in the Rocky Mountains, the bracts are thick, almost fleshy, obtusish, lanceolate, and often nearly equaling the pedicels. In the bracts and inflorescence, it resembles more *P. farinosa* L. of Europe and northeastern America. *P. Ellisiae* of the Sandea Mountains of New Mexico, though belonging to this group and of the same habit, has much larger flowers, the lobes of the corolla being 8–10 mm. long. *P. specuicola* grows only in loose soil, under overhanging cliffs in the alcove-like heads of the canyons, characteristic of the limestone bluffs of San Juan River.

UTAH: Along San Juan River, near Bluffs, Aug. 25–29, 1911, *Rydberg 9882* (type, in herb. N. Y. Bot. Gard.); same locality, Feb., 1912, *Edna Scorup*, and in 1895, *Alice Eastwood*.

Androsace albertina Rydb. sp. nov.

Cespitose perennial, but scarcely pulvinate; leaves narrowly oblanceolate, about 1 cm. long, sparingly ciliate, not carinate; scape 5–10 cm. long, slender, sparingly hairy; bracts linear-lanceolate, 3–4 mm. long; pedicels 3–5 mm.; calyx-lobes elliptic, obtuse; corolla-lobes 2–3 mm. long.

This is most like the European *A. Chamaejasme* Host, but the leaves and bracts are narrower. It differs from *A. carinata* Torr. in the narrower leaves, not carinate beneath, less pulvinate habit, longer peduncles, longer pedicels, and smaller flowers.

ALBERTA: Lake Agnes, National Park, Banff, Aug. 1897, *Mr. and Mrs. C. Van Brunt 77* (type, in herb. N. Y. Bot. Gard.); Jumping Pound Creek, June 14, 1897, *Macoun 23478;* Rocky Mountains 1858, *Bourgeau*.

MONTANA: Yellow Mountain, June 24, 1897, *R. S. Williams*.

Androsace simplex Rydb. sp. nov.

Annual; leaves oblanceolate, 3–6 mm. long, acute, entire, minutely puberulent; scape usually solitary, erect, very slender, 2–7 cm. high; bracts oval or lance-oval, 2–4 mm. long; pedicels

5–15 mm. long, suberect or strongly ascending; calyx-tube obpyramidal, about 2 mm. long; lobes lanceolate, about 1.5 mm. long, acute; corolla small, shorter than the calyx.

This is related to *A. occidentalis*, but the plant is more delicate, the scapes solitary, bearing a 1–4-flowered umbel with strongly ascending or nearly erect pedicels, the bracts smaller and distinctly acute.

MONTANA: Missoula, May, 1897, *Elrod & assistants 33* (type, in herb. N. Y. Bot. Gard.).

UTAH: Near Salt Lake City, May 1882, *M. E. Jones.*

BRITISH COLUMBIA: Lytton, April 17, 1889, *Macoun.*

Dr. Greene separates an American species *Androsace capillaris* Greene from the Asiatic *A. filiformis* Retz, and claims that the former is a perennial. All American specimens that I have seen are, however, annuals, and I can see no reason for such a separation.

Dodecatheon Jaffreyi Moore has been collected near Sawtooth, Idaho, by Evermann.

GENTIANACEAE

Anthopogon ventricosum (Griseb.) Rydb.

Gentiana ventricosa Griseb. in Hook. Fl. Bor.-Am. 2: 65. 1838.

Anthopogon Macounii (Holm) Rydb.

Gentiana Macounii Holm, Ottawa Nat. **15**: 110, 179. 1901.

Anthopogon tonsum (Lunell) Rydb. sp. nov.

Gentiana detonsa tonsa Lunell, Bull. Leeds Herb. **2**: 7. 1908.

This is closely related to *A. Macounii* (Holm) Rydb., but differs in the glabrous filaments, a character not pointed out by Dr. Lunell.

Amarella tortuosa (M. E. Jones) Rydb.

Gentiana tortuosa M. E. Jones, Proc. Calif. Acad. II. **5**: 707. 1895.

Amarella ventorum Rydb. sp. nov.

Gentiana arctophila densiflora Torr. Fremont's Rep. 94. 1845. Not *G. arctophila densiflora* Griseb.

Low annual or biennial, branched near the base; stems 5–10 cm. long, branched, internodes shorter than the leaves; basal leaves oblanceolate; stem-leaves linear or linear-lanceolate, about 2 cm., acute; flowers 1–3 in the axils; pedicels 2–8 mm. long; calyx-tube about 2 mm. long; lobes linear-lanceolate, 3–5 mm. long, acute, scabrous on the margins; corolla about 5 mm. long; lobes ovate, obtuse or acute; crown none.

This little *Amarella* lacks the setaceous fimbriate crown at the base of the corolla-lobes and therefore should be classified with the arctic or subarctic *A. propinqua* (Richards.) Greene, and *A. arctophila* (Griseb.) Greene, but the corolla-lobes are acute or obtuse, instead of cuspidate.

WYOMING: Wind River Moutainns, Aug. 4, 1843, *Fremont.*

Dasystephana oregana (Engelm.) Rydb.

Gentiana oregana Engelm.; A. Gray, Syn. Fl. 2[1]: 122. 1878.

Dasystephana glauca (Pall.) Rydb.

Gentiana glauca Pall. Fl. Ross. **2**: 104. 1784.

Dasystephana calycosa (Griseb.) Rydb.

Gentiana calycosa Griseb. Gen. et Sp. Gent. 292. 1839.

Dasystephana monticola Rydb. sp. nov.

Gentiana calycosa stricta Griseb. Gen. et Sp. Gent. 292. 1839.

Gentiana calycosa monticola Rydb. Bull. Torrey Club **24**: 252. 1897.

Dasystephana obtusiloba Rydb. sp. nov.

Cespitose perennial; stems erect or ascending, about 1 dm. high; internodes short, equaling or a little longer than the leaves; leaves very broadly ovate, 3–5-ribbed, usually acute at the apex and subcordate at the base; calyx-tube broadly turbinate, 5–6 mm. long; lobes broadly oval, rounded at the apex, often overlapping, about 8 mm. long; corolla dark blue, about 3.5 cm. long; lobes rounded at the apex; lobes of the plaits about half as long as the corolla lobes.

This is related to *D. calycosa*, but differs in the lower habit and rounded corolla-lobes.

MONTANA: Mary Baker Lake and Sperry Glacier, Aug. 21, 1901, *Vreeland 1162* (type, in herb. N. Y. Bot. Gard.); Lake MacDonald, Aug. 22, 1901, *Umbach 371;* Mount MacDonald, July 25, 1900, *Elrod & assistants;* Silloway Peak, July 17–19, 1901, *MacDougal 692;* Blackfoot Indian Reservation, Aug. and Sept. 1909, *Gilman Thompson.*

Swertia Fritillaria Rydb.

Glabrous, light green, perennial; stem 1.5–3 dm. high; basal leaves and lower stem-leaves alternate, 6–10 cm. long, thin, long-petioled; blades obovate, spatulate, rounded at the apex, abruptly contracted into winged petioles of about the same length; middle and upper stem-leaves all alternate or a single pair of opposite ones, oblanceolate or oblong; inflorescence rather lax, elongate; pedicels 1–2 cm. long; sepals lanceolate, about 6 mm. long; corolla-lobes lanceolate, mostly acute, greenish white along the midrib and azure along the margins, dotted all over with dark blue spots in the manner of many species of *Fritillaria;* filaments more or less dilated, some of them very broad; glands inconspicuous with rather long blue fringes.

UTAH: Wet places in caynons: Big Cottonwood Canyon, August 4, 1905, *Garrett 1566* (type, in herb. N. Y. Bot. Gard.).

APOCYNACEAE

Amsonia Eastwoodiana Rydb. sp. nov.

Perennial, with a short woody base; stem 3–5 dm. high, glabrous; stem-leaves lanceolate, usually narrowly so, 3–5 cm. long, glabrous, acute at each end; leaves of the numerous strongly ascending branches linear; calyx-lobes subulate, 2 mm. long or longer; corolla 16–20 mm. long; tube narrowly trumpet-shaped; lobes nearly 4 mm. long; pod 5–8 cm. long, about 8 mm. thick, constricted and often breaking off between the seeds, 3–5-seeded; seeds oblong, about 1 cm. long and 6 mm. thick.

This is most closely related to *A. brevifolia*, having the same flower and fruit, but the plant is in habit more like *A. Fremontii*, for which it has been mistaken. The latter has still longer calyx-lobes which are narrower, and its pod is not restricted between the seeds. In canyons of desert regions.

UTAH: Moab, July, 1911, *Rydberg & Garrett 8468* (fruit, type, in herb. N. Y. Bot. Gard.); Willow Creek Canyon, August, 1895, *Alice Eastwood 73* (fruit).

ARIZONA: Ten miles east of Holbrook, June 22, 1901, *L. F. Ward* (flowers); Lee's Ferry, 1890, *M. E. Jones*.

Amsonia texana (A. Gray) Heller of the Flora of Colorado and Coulter & Nelson's Manual is *A. latifolia* Jones. *A. brevifolia* A. Gray, and *A. tomentosa* Torr. have been collected in southern Utah.

ASCLEPIADACEAE

Astephanus utahensis Engelm., *Philibertella cynanchoides* (Dec.) Vail and *P. heterophylla* (Engelm.) Vail, *Asclepias erosa* Torr., *A. macrosperma* Eastw. and *A. labriformis* Jones have been collected in Utah; *Acerates lanuginosa* (Nutt.) DC., in the Yellowstone Park; *Asclepias ovatifolia*, in Saskatchewan; and *Asclepias mexicana* Cav., in Idaho.

CONVOLVULACEAE

Cressa erecta Rydb. sp. nov.

Stem branched, with a woody base, erect, 2–3 dm. high with erect branches, silvery canescent; leaves elliptic, 5–7 mm. long, acute at both ends, sessile, silvery canescent; pedicels in fruit 6–10 mm. long, usually exceeding the leaves; bracts elliptic, 3 mm. long; sepals 4–5 mm. long, oval, equaling the corolla-tube; corolla white; lobes elliptic, acutish, rarely spreading; filaments filiform, slightly pubescent; ovary densely pubescent; styles filiform.

This differs from *C. depressa* Goodding in the erect stem and branches, the more silvery pubescence, the longer pedicels (in *C. depressa* shorter than the leaves) and the comparatively narrower corolla-lobes.

UTAH: Near Beck's Hot Springs, Salt Lake County, July, 1905, *Garrett 870f* (type, in herb. N. Y. Bot. Gard.).

CUSCUTACEAE

Cuscuta curta (Engelm.) Rydb. sp. nov.

Cuscuta Gronovii curta Engelm. Trans. St. Louis Acad. **1**: 507. 1859.

In saline districts of Utah and Colorado.

POLEMONIACEAE

Dr. Brand* reduces the amply distinct *Phlox muscoides* Nutt. to

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* Pflanzenreich, Vol. 4, Fam. 250. The following pages contain a good deal of criticism of Dr. Brand's monograph of this family. The monograph is one of the best, differing in that respect from most works done by Europeans on American plants. The citation of publication is very carefully prepared, correct, and complete; but Dr. Brand has fallen into the same errors as most foreigners do, in not trying to find out exactly what the types are or what plants the descriptions really represent. He made definite pronunciations as to species he had never seen, and made synonyms from mere guesses. My criticisms are limited to the Rocky Mountain species. If the Pacific Slope species are considered, probably as many more incongruities could be pointed out.

a subspecies of *P. caespitosa* and makes *P. Covillei* E. Nels. and *P. condensata* (Gray) E. Nels. varieties of this subspecies. It is evident that Dr. Brand does not know what *P. muscoides* is; for the only Montana specimen he cites is *Rydberg & Bessey 4815*, which belongs to *Phlox caespitosa* and is so referred in my Flora of Montana. He also cites two specimens from California, *Coville 2072* from Mount Whitney and *Hildebrand* from Silver Mountains and also one from Charleston Mountains, Nevada, *Purpus 6111*. *Phlox muscoides* Nutt. is unknown to both California and Nevada. Neither *P. Covillei* nor *P. condensata* is closely related to *P. muscoides*. The relationship of *P. muscoides* is with *P. bryoides* on one hand, and *P. Hoodii* on the other; and the calyx is arachnoid-villous, not glandular as in *P. caespitosa*.

Dr. Brand made *Phlox albomarginata* M. E. Jones, *P. costata* Rydb., *P. collina* Rydb. and *P. diapensioides* Rydb. varieties of *P. Kelseyi*, while he kept *P. alyssifolia* Greene as distinct and described a new species, *P. variabilis*, from material which I had included in *P. collina*. It is evident that Dr. Brand did not know the plants he was so treating. Under his var. *albomarginata* he gives the following distribution:

"Montana (nach Jones)—Wyoming: Cooper Creek (Nelson n. 4336)."

Evidently he had not seen Jones's specimens and *Nelson 4336* is typical *P. Kelseyi*, and has nothing of the habit of *P. albomarginata*.

Under each of his var. *collina* and var. *diapensioides* he gives the following: "Montana (nach Rydberg)." In other words, he had seen no specimens. Under his var. *costata* he gives: "Montana: Madison Co. (Nelson 5148)." This number is not found in the herbarium of the New York Botanical Garden, but judging from the rest I am inclined to think that this determination is just as unreliable. It may be that *5148* is a misprint for *5418*, which is labeled *Phlox Kelseyi*, and should be referred to it, but is not typical. It has nothing to do with *P. costata*. Furthermore, *P. costata* is not closely related to *P. Kelseyi*, but intermediate between *P. multiflora* A. Nels. and *P. glabrata* (A. Nels.) Brand, but with a densely pubescent calyx.

In my opinion, *P. alyssoides* Greene, *P. collina* Rydb., and *P.*

variabilis Brand are one and the same species. I included *Hall & Harbour 454* in the original description of *P. collina*, and I have no reason for changing my opinion. There is no essential difference between my diagnosis of *P. collina* and Brand's characterization of *P. variabilis*, except that I described the leaves as "oblong or ovate" and Brand gives them as "linear." The specimens in the Columbia University herbarium of *Hall & Harbour 454* have oblong leaves, hence agreeing better with my description. Furthermore, *P. alyssoides* (= *P. collina*), as I understand it, has been collected at several places in both Utah and Wyoming, and why not also in Colorado? Professor A. Nelson in Coulter & Nelson's New Manual has followed Dr. Brand's treatment of this group very closely. It would have been much better for him to find out the real facts.

Brand's description of *P. Douglasii* is not correct; he describes the calyx as eglandulose-pilose, while the duplicate of the type in the Columbia University herbarium is densely glandular.

Phlox dasyphylla Brand is not better than *P. variabilis*, being only a small-flowered and narrow-leaved form of *P. multiflora*, not uncommon in Colorado and Wyoming.

Phlox densa Brand is a low condensed from of *P. austromontana*, more like the type than *Phlox austromontana prostrata* E. Nels., which Dr. Brand regards as a mere variety. The only one of Dr. Brand's new species from the Rockies that I regard as good is *P. glabrata* (E. Nels.) Brand (*P. Hoodii glabrata* E. Nels.).

In describing *Phlox aculeata** Prof. A. Nelson compares it with the *P. caespitosa* group. The intercostal portion of the calyx is replicate, however, which would associate it with *P. Stansburyi*. I can not distinguish it from *P. viridis* E. Nels.

Dr. Brand's conception of *Gilia congesta* Hooker is entirely wrong. He regards *G. iberidifolia* Benth. as the typical *G. congesta*. A duplicate of Douglas's plant is found in the Columbia University herbarium, and a closer study of the same shows that it is the same as Jenney's plant from the Black Hills, which constituted a part of *G. spicata capitata* A. Gray, and my number *886*, also from the Black Hills. These two specimens I included in my *G. cephaloidea*. Unfortunately I did not designate a type and some botanists might claim that Jenney's plant which was first

* Bot. Gaz. **52**: 270. 1911.

mentioned should be regarded as such. The short characterization was, however, drawn principally from my number *2763* from Lima, Montana, and this is marked in our herbarium as the type. Since more specimens have been seen, both of the Montana plant and of that from the Black Hills, it has become evident that they are not exactly the same. As the Montana plant is marked as the type, I now limit my *G. cephaloidea* to it. If Jenney's plant or my *886* were to be regarded as the type of *G. cephaloidea*, this would become a synonym of *G. congesta* and the Montana plant should have a new name. As it is, the *G. cephaloidea* of Brand's monograph should become *G. congesta* Hooker, and Brand's *G. congesta* is *G. iberidifolia* Benth.

Brand divides the *Gilia spicata* group in two divisions: one containing *G. spicata*, *G. globularis* and *G. trifida*, with the corolla-lobes (in dry state) dark purple; and *G. cephaloidea* and *G. congesta*, with lobes of the corolla (in dry state) whitish. The dark purple color is simply due to poor drying. Dr. Brand also describes the corollas of *G. spicata* as purple. In fact they are greenish white. We have specimens of *G. spicata* which still retain the greenish white color. Such a distinction is scarcely scientific.

Under *Gilia congesta iberidifolia*, Dr. Brand gives as synonyms *G. spergulifolia* Rydb. and *G. roseata* Rydb. Evidently Dr. Brand had not seen a specimen of *G. roseata*. This is perhaps closer related to his own *G. globularis* than to *G. iberidifolia*, except that the stems are branched and bear several heads. He had seen a specimen of *Baker 534*, which I referred to *G. spergulifolia*. When doing so I had in mind only the specimen in the herbarium of the New York Botanical Garden. I do not know by what this number may be represented elsewhere. However, I can not distinguish this from *Nelson 5430*, which Dr. Brand refers to the var. *crebrifolia*, evidently not knowing that the var. *Merrillii* (*G. Merrillii* A. Nels.) is the original *G. crebrifolia* Nutt. A duplicate of the type is in the Columbia University herbarium. The synonomy of this group of Gilias is therefore very mixed. In order to straighten out the matter I give the following synonymy:

GILIA SPICATA Nutt. Jour. Acad. Nat. Sci. Phila. II. 1: 156. 1848.

GILIA GLOBULARIS Brand, Pflanzenreich 4^{250}: 120. 1907.

Gilia spicata capitata A. Gray, Proc. Am. Acad. **8**: 274 (as to type). 1870.

Gilia cephaloidea Rydb. Fl. Colo. 277, in part. 1906.

GILIA CEPHALOIDEA Rydb. Bull. Torrey Club **24**: 293 (as to the Montana plant). 1897.

GILIA CONGESTA Hook. Fl. Bor.-Am. 2: 75. 1838.

Gilia spicata capitata A. Gray, Syn. Fl. 2^1: 144, in part. 1878.

Gilia cephaloidea Rydb. Bull. Torrey Club **24**: 293, in part. 1897.—Brand, Pflanzenreich 4^{250}: 121. 1907.

GILIA IBERIDIFOLIA Benth. in Hook. Jour. Bot. & Kew Misc. **3**: 290. 1851.

Gilia congesta iberidifolia Brand, Pflanzenreich 4^{250}: 121. 1907.

Gilia nuda (Eastw.) Rydb.

Gilia congesta nuda Eastw. Proc. Calif. Acad. II. **6**: 308. 1896.

GILIA ROSEATA Rydb. Bull. Torrey Club **31**: 633. 1904.

GILIA SPERGULIFOLIA Rydb. Bull. Torrey Club. **31**: 633. 1904.

Gilia congesta crebrifolia S. Wats. Bot. King Exped. 5: 268, in part. 1871.

Gilia congesta iberidifolia crebrifolia Brand, Pflanzenreich 4^{250}: 121. 1907.

GILIA CREBRIFOLIA Nutt. Jour. Acad. Nat. Sci. Phila. II. **1**: 156. 1848.

Gilia congesta crebrifolia A. Gray, Proc. Am. Acad. **8**: 273. 1870.

Gilia Merrillii A. Nels. Bot. Gaz. **34**: 27. 1902.

Gilia congesta iberidifolia Merrillii Brand, Pflanzenreich 4^{250}: 122. 1907.

GILIA BURLEYANA A. Nels. Bot. Gaz. **54**: 144. 1912.

This species also belongs to this group. Prof. Nelson stated in the original description: "Until now this section contained no perennials." Both *G. iberidifolia* and *G. roseata* are perennials. Gray divides the group in "annuals and short lived perennials or biennials."

Gilia palmifrons (Brand) Rydb. sp. nov.

Gilia congesta palmifrons Brand, Pflanzenreich 4^{250}: 122. 1907.

I think also that Dr. Brand has misidentified *Gilia trifida* Nutt.

Dr. Brand evidently drew his description from *Jones 5949*, the only specimen he cited. He described the stamens as being inserted in the middle of the corolla-tube, while Nuttall described them as inserted in the throat. I have not seen Nuttall's type, but I have collected in the region of the type locality, Scott's Bluffs, Nebraska. The only species growing there are *G. spicata* and *G. iberidifolia*. I believe that Dr. Gray interpreted *G. trifida* Nutt. correctly as a depauperate form of *G. spicata*. If this is correct, Brand's *G. trifida* must receive a new name.

Gilia frutescens Rydb. sp. nov.

Fruticose, perennial; stems woody below, branched above, 3–5 dm. high; herbaceous branches 2–3 dm., sparingly pubescent; leaves linear, glabrous or nearly so, simple, 2–5 cm. long, 1–2 mm. wide, callous-tipped; flowers capitate at the ends of the branches; calyx crisp-hairy; teeth lanceolate, cuspidate, shorter than the tube; corolla white, 5–6 mm. long, salvershaped; tube barely exserted; lobes about 2.5 mm. long, oval, acute; stamens inserted in the throat; filaments short; style glabrous, nearly as long as the corolla tube.

The type was labeled *Gilia multiflora*, to which it is not related. It belongs to the *G. iberidifolia* group, and has as entire leaves as *G. spergulifolia* and *G. crebrifolia*, but the habit is different. It differs from all its relatives in the tall shrubby habit. The other species are at most suffruticose and less than 3 dm. high.

UTAH: Springdale, May 14, 1894, *M. E. Jones 5247* (type, in herb. N. Y. Bot. Gard.; duplicate in U. S. Nat. Herb. *no. 326910*).

Dr. Brand has treated the *G. aggregata* group as carelessly as that of the *G. congesta* relatives. It is evident that he has had no specimens of *G. candida* Rydb. and still he makes it *Gilia aggregata* var. *attenuata* forma *candida*, giving *Callisteris leucantha* Greene as another synonym. If he had only read my description, he would not have committed this blunder, for I distinctly pointed out that the lobes of the corolla in *G. candida* are rounded or obtuse at the apex like those of *G. longiflora*. It is a plant with the habit and leaves of *G. aggregata* and the corolla of *G. longiflora*. Both *Callisteris attenuata* and *C. leucantha* have attenuate corolla-lobes and the former is a white-flowered form of *Gilia pulchella* Dougl.,* a species wholly omitted by Dr. Brand. Dr. Brand cited

* Hook. Fl. Bor.-Am. 2: 74. 1838.

two specimens under the forma *candida*, viz. *Nelson 4198* (should have been *4189*) and *Clements 13*. The former is a white-flowered form of *G. pulchella*, the latter belongs to *Gilia scariosa* Rydb. Dr. Brand did not notice the different structure of the calyx, which places *G. scariosa* close to *G. aggregata Bridgesii* A. Gray. Nelson in the New Manual has also confused things. *Gilia scariosa* is made a synonym of *G. aggregata* and *G. candida* of *G. attenuata*. He has also overlooked the characters of the calyx of *G. scariosa* and the rounded corolla-lobes of *G. candida*.

Gilia arizonica (Greene) Rydb.

Callisteris arizonica Greene, Leaflets 1: 160. 1905.

Gilia aggregata typica arizonica Brand, Pflanzenreich 4^{250}: 115. 1907.

Gilia tenuituba Rydb. sp. nov.

Biennial; stem about 3 dm. high, finely glandular-puberulent; leaves pinnatifid with narrowly linear, puberulent, cuspidate divisions; inflorescence a thyrsoid panicle, puberulent; flowers short-pedicelled; calyx campanulate, glandular-puberulent, distinctly scarious in the sinuses; teeth lance-subulate, cuspidate, longer than the tube; corolla flesh-colored, nearly 4 cm. long; tube slender, 1 mm. thick below and 2 mm. at the throat; lobes narrowly lanceolate, attenuate, nearly 1 cm. long; stamens unequally inserted far down the corolla-tube, included; style slender, about equaling the corolla-tube.

UTAH: Beaver City, 1877, *E. Palmer 329* (type, in herb. Columbia Univ.). This is also related to *G. aggregata*.

Gilia hutchinsifolia Rydb. sp. nov.

Gilia arenaria rubella Brand, Pflanzenreich 4^{250}: 103. 1907.

This differs from *G. arenaria* Benth. and *G. sinuata* Dougl. in the acute corolla-lobes and broad and again lobed divisions of the leaves. The description "*Caulis inferne (an morbo?) rufo-lanatus*," from which Dr. Brand adopted the varietal name, is wholly erroneous. The red coloring is simply grains of red sand adhering to the specimens. This is the reason of my not adopting the varietal name.

Gilia straminea Rydb. sp. nov.

Annual; stem 2–3 dm. high, glabrous, or rarely slightly glandular-puberulent above, straw-colored, simple below, with a few almost erect branches above; basal leaves glabrous, firm, 1–2 cm. long, pinnately lobed, with lanceolate cuspidate-tipped lobes; stem-leaves sessile and partly clasping, lanceolate, sharply dentate with cuspidate teeth or entire; calyx-tube campanulate, 2 mm. long, somewhat scarious in the sinuses, sparingly glandular-puberulent; teeth subulate, 1 mm. long; corolla trumpet-shaped, 7–8 mm. long; tube nearly twice as long as the calyx; capsule exceeding the calyx; seeds 5 or 6 in each cell.

This is related to *G. sinuata*, but differs in the simple, straw-colored, essentially glabrous stem, the glabrous, pale green leaves, and the form and toothing of the stem-leaves.

UTAH: St. George, 1877, *E. Palmer 325*,* in part (type, in herb. Columbia Univ.); also *326*.

Dr. Brand reduced *Gilia Tweedyi* Rydb. to a variety of *G. minutiflora*, without having seen a specimen. I do not think that it is rational to do so, for in *G. Tweedyi* the pod is not 1-seeded, but bears 1–3, usually 2, seeds in each cell, i. e., it is 4-seeded. The plant is more closely related to *G. inconspicua*.

Dr. Brand made *Gilia Haydeni* A. Gray a variety of *G. subnuda* Torr., and gave *G. Crandallii* Rydb. as a synonym of this variety. Professor Nelson regarded *G. Crandallii* as the same as *G. subnuda* and gave *G. Haydeni* and *G. superba* Eastw. as varieties of the same. Both arrangements are incorrect. *G. superba* Eastw. is the typical *G. subnuda* Torr. characterized by the orange or scarlet corolla. In both *G. Haydeni* and *G. Crandallii* the corolla is rose-colored. They are quite distinct from *G. subnuda* and in my opinion distinct from each other.

Dr. Brand's treatment of *Leptodactylon pungens* (Torr.) Nutt. or *Gilia pungens* (Torr.) Benth. and its relatives is far from satisfactory. He divides it in two subspecies: subsp. A. *eu-pungens* and subsp. B. *Hallii* (*Gilia Hallii* Parish), which is a matter of taste, but he also divides the former in four varieties: a. *Hookeri* (Dougl.) Brand; b. *caespitosa* (Nutt.) Brand; c. *tenuiloba* (Parish) Brand; and d. *devestita* Brand.

The first variety is based on *Gilia Hookeri* Benth. To make this species a variety of *G. caespitosa* could be also passed over, as

* The same number in the herbarium of the New York Botanical Garden is entirely different, and belongs to *Gilia hutchinsifolia*. Maybe some mixing of the labels occurred.

a matter of taste, but Dr. Brand in his treatment usually meant by the variety *a* the typical form. If that is his intention here, he is wholly mistaken, for the type is not viscid. Torrey's type should be placed under his variety *b. caespitosa*, and is exactly like *Goodding 32* and *Parry 236* from Wyoming, which Dr. Brand also refers to that variety. In fact Dr. Brand seems not to know *Leptodactylum caespitosum* Nutt. (*Gilia pungens caespitosa* A. Gray), although he adopts this name for a variety which proves to be the original *G. pungens*. *Leptodactylon caespitosum* is amply distinct, not only by the characters given by Dr. Gray, but also by the 4-merous flowers and the stamens inserted in the tube. All the other species have 5-merous flowers. *Gilia Hookeri* is confined to the western slope and does not extend into Utah, Colorado, New Mexico, and Arizona, as stated by Dr. Brand. The following specimens are wrongly referred to it: *Elmer 502* is typical *G. pungens; Jones 1784* and *MacDougal 183* belong to *G. pungens squarrosa* A. Gray. The Matthews' specimens I have not seen, but I think they also are wrongly referred to it. Of the specimens cited under the variety *devestita*, all I have seen belong to typical *G. pungens*, some of them having slightly longer leaves than the type, but not all.

Leptodactylon brevifolium Rydb. sp. nov.

Suffruticose, branched perennial, 1–2 dm. high; stems puberulent and slightly glandular above; leaves 3–5 mm. long, glandular-puberulent or glabrate, 3–5-divided into subulate, acerose, ascending divisions; calyx about 8 mm. long, glandular-puberulent; teeth subulate-acerose, much shorter than the tube; corolla trumpet-shaped, about 15 mm. long; stamens inserted in the throat of the corolla.

This is related to *Leptodactylon pungens* (Torr.) Nutt. and *L. Hookeri* (Dougl.) Rydb. (*Phlox Hookeri* Dougl.; *Gilia Hookeri* Benth.) but has much shorter leaves. The habit and flower are more like the former, but the calyx and young foliage are more or less glandular, though not so copiously so as in the latter.

UTAH: Juniper Range, 1898, *Purpus 6306* (type, in U. S. Nat. Herb.; duplicate in herb. N. Y. Bot. Gard.); Cedar City, *M. E. Jones 5204a;* Montezuma Canyon, *Eastwood;* rocky hills on the San Juan, *Newberry*.

?COLORADO: Gunnison, Aug. 16, 1901, *Baker 830* (doubtful, without flower).

NEW MEXICO: Cedar Hill, San Juan County, *Standley 7998*.

WASHINGTON: Coulee City to Ephrata, June 1902, *Griffiths & Cotton 471*.

NEVADA: Panaca, *V. Bailey 1971*.

Dr. Brand excluded *Gilia caespitosa* A. Gray not only from the genus but also from the family. He makes the following remark: "Species foliis calcareo-glandulosis ab omnibus Polemoniaceis valde abhorret; fortasse Saxifragaceis attributa est."

The leaves are by no means "calcareo-glandulosis," but merely viscid-pubescent as described by Dr. Gray. In the type they are covered by grains of sand, that is all. It is without doubt a species of *Gilia* and probably, as Dr. Gray suggested, related to *G. subnuda*, but as the corolla was unknown the placing in the genus was uncertain. One thing is certain, it should not be placed next to *G. rigidula* as it is in the Synoptical Flora. The duplicate of the type in the National Herbarium bears a single withered and partly torn corolla; this is trumpet-shaped and about 1 cm. long; the real structure is not possible to make out, but the plant is probably related to *G. subnuda*.

Dr. Brand gives *Micranthes diffusa* as a synonym under *Gilia gracilis* subspecies *humulis* var. *micrantha*, while he cites *Heller 3098* (its type) under *G. gracilis* subsp. *eu-gracilis* var. *eritrichoides*, which shows carelessness in identifying the different forms described. In the Columbia University herbarium there is a duplicate of Douglas's collection, which shows that Brand's var. *eritrichoides* is the typical form of *Microsteris gracilis* (Dougl.) Greene.

Dr. Gray in his Synoptical Flora* segregated out *Gilia aristella* from material he had previously included in *Collomia linearis subulata*. The latter he regarded as the same as *Collomia tinctoria* Kellogg. Notwithstanding this judgment of Dr. Gray, which always will weigh considerably, Dr. Brand made *Collomia aristella* (A. Gray) Rydb. a synonym of *C. tinctoria* Kellogg, while he named *C. tinctoria subulata* (A. Gray) Brand from Gray's variety *C.*

* 2^1: Suppl. 408. 1886.

linearis subulata. Dr. Brand did not give any reason for this change. Furthermore, he did not cite any specimens of his *C. tinctoria* from California and I have seen no specimens of *C. aristella* from that state. Of the variety *subulata*, on the contrary, there are several collections from California in our herbaria. There is nothing either in Kellogg's description or in his figure which would indicate that Dr. Gray had made a misinterpretation. Kellogg's figure is drawn from a young, simple, undeveloped plant, and the peculiar branching of the var. *subulata* in age does not show. Whether *C. tinctoria* and *C. aristella* should be united into one species is another question, but in such a case the variety *subulata* should have been made the species, viz., *C. tinctoria* Kellogg, and *C. aristella* a variety thereof; and this for the following reason: The variety *subulata* is certainly found in the type region of *Collomia tinctoria*, while *C. aristella* apparently is not. Seen from another standpoint, the local and more specialized *C. aristella* must be regarded as the derivative of the more common and less specialized *C. tinctoria* (i. e., the var. *subulata*).

Brand transferred *Gilia sinister* M. E. Jones to *Collomia* without having seen the plant. This was probably because Mr. Jones placed it in the *Collomia* section and compared it with *G. aristella*. But Jones also made the following statement: "This has the general appearance of *G. inconspicua*, but without the basal leaves." The relationship is also with *G. inconspicua*. Several of the species of that group have the calyx enlarged somewhat in fruit; this is true in *G. sinister*, but it is at last ruptured by the capsule and does not have the structure of the calyx in *Collomia*. It is in my opinion a true *Gilia*.

Dr. Brand included a number of forms, in my judgment several good species, under *Polemonium pulcherrimum* Hook. He divides it in three subspecies, *tricolor*, *delicatum*, and *parvifolium*. The first is separated by its tricolored flowers and equals *P. tricolor* Eastw. The other two subspecies he separated only by the length of the leaflets, a very poor character to use for separating subspecies.* He overlooked the fact that in all these forms included

* Under var. *Haydenii* Dr. Brand made the following remarks: "The forms from the southern Rocky Mountains, which could be counted to this, are better to be regarded as depauperate forms of subsp. *delicatum*."

in the subspecies *delicatum*, the stem is pubescent with long white spreading hairs and the leaflets are decidedly acute, while in the forms included in the subspecies *parvifolium*, the stem is merely puberulent and the leaflets usually obtuse.

The specimens cited under the subspecies *delicatum* belong to three or four different species. Those from Colorado and Utah belong to *P. scopulinum* Greene and *P. delicatum* Rydb., which perhaps may not be specifically distinct. Those from California belong to *P. californicum* Eastw. Those from Washington and perhaps those from Oregon to an undescribed species, characterized below.

The subspecies *parvifolium* was divided in var. α *Haydenii* and var. β *pilosum* (= *P. pilosum* Greenman). It is very hard to interpret Dr. Brand's arrangement. He gives under the subspecies *parvifolium* the following synonyms: *P. parvifolium* Nutt.; *P. coeruleum* J. Hook.; *P. mexicanum* Nutt.; *P. viscosum* A. Gray, not Nutt., but cited no specimens. His usage as well as that of most European botanists is to designate the typical form by var. α. Hence var. α *Haydenii* is the typical form of subsp. *parvifolium*, and still under this he has the following synonyms: *P. Haydeni* A. Nels., *P. montrosense* A. Nels., and *P. Tevisii* Eastw. *P. parvifolium* Nutt. is the same as *P. mexicanum* Nutt. and *P. viscosum* A. Gray, and is characterized by its small dense inflorescence and its obtuse calyx-lobes, or the latter even rounded at the apex; but it is not the same as *P. coeruleum* γ Hook., or *P. Haydeni* A. Nels., or *P. Tevisii* Eastw.

Polemonium coeruleum γ Hook. is the original *P. pulcherrimum* Hook., and this should have been made subsp. A var α, according to Brand's system. *P. Haydeni* resembles it closely in flowers, leaves and pubescence, but differs considerably in general habit and the inflorescence.

Polemonium columbianum Rydb. sp. nov.

Perennial, with a branched rootstock and caudex; stems several, 2–3 dm. high, viscid-pubescent with flattened hairs, and distinctly glandular in the inflorescence; leaves 5–15 cm. long, likewise sparingly viscid-pubescent, pinnate; leaflets 9–19, elliptic or lance-elliptic, acute, 1.5–3 cm. long; inflorescence corymbiform-paniculate; calyx about 6 mm. long, glandular-puberulent and pubescent; lobes lanceolate, acute, fully equaling the tube; corolla 10–12 mm. long, open-campanulate, violet with yellowish base; lobes rounded-truncate at the apex; stamens two thirds to three fourths as long as style and slightly longer than the corolla.

This resembles *P. scopulinum* Greene in habit, but is a larger plant with much larger flowers. It grows in the mountains of Idaho and Washington at an altitude of 1,500–2,000 m.

IDAHO: Divide between St. Joseph and Clearwater Rivers, July 9, 1896, *Leiberg 1205* (type, in herb. N. Y. Bot. Gard.); Wiesner's Peak, July 8, 1892, *Sandberg, MacDougal & Heller 1049.*

WASHINGTON: Wenatchee Mountains, July, 1897, *Elmer 456;* Goat Mountain, Aug. 12, 1896, *Allen 262;* Clallam, July, 1900, *Elmer 2819;* Palace Camp, 1883, *Mrs. Bailey Willis.*

Polemonium intermedium (Brand) Rydb. sp. nov.

Polemonium occidentale intermedium Brand, Pflanzenreich 4^{250}: 33. 1907.

This I think is well worth specific rank. It is confined to the Columbia River region of Idaho, Washington, and British Columbia.

Dr. Brand regarded *Polemonium speciosum* Rydb. as a good species. Professor Nelson on the other hand makes it a variety of *P. mellitum* (A. Gray) A. Nels., which is evidently erroneous. If it should be made a variety of any of the verticillate species of *Polemonium*, it should have been of *P. viscosum* Nutt. or rather of *P. Grayanum* Rydb., which species Professor Nelson does not regard as distinct. *P. speciosum* has a short blue corolla and subcapitate inflorescence.

HYDROLEACEAE

Hydrophyllum Watsonii (A. Gray) Rydb. sp. nov.

Hydrophyllum occidentale Watsonii A. Gray, Proc. Am. Acad. 10: 314. 1875.

Miltitzia foliosa (Jones) Rydb.

Emmenanthe foliosa M. E. Jones, Zoe 4: 278. 1893.

The *Miltitzia* section of *Emmenanthe* of Gray's Synoptical Flora, I think is generically distinct from *Emmenanthe* proper, and DeCandolle's genus *Miltitzia* should be restored. The latter genus is represented in the Rocky Mountain region by this and the two following species.

Miltitzia salina (A. Nels.) Rydb.

Emmenanthe salina A. Nels. Bull. Torrey Club **25**: 381. 1898.

Miltitzia scopulina (A. Nels.) Rydb.

Emmenanthe scopulina A. Nels. Bull. Torrey Club **25**: 380. 1898.

Phacelia orbicularis Rydb. sp. nov.

Biennial or annual; stems 1–2 dm. high, glandular-villous, often tinged with red, branched; leaves petioled; blades suborbicular in outline, crenately lobed, 1.5–2.5 cm. long, hirsute as well as glandular; racemes many-flowered; calyx-lobes oblong or oblanceolate, obtuse, 3 mm. long; corolla purplish, 6 mm. long, campanulate-funnelform; lobes crenulate; filaments about twice as long as the corolla; seeds faveolate, crenately lobed on the margins and the median ridge.

This is related to *P. integrifolia*, but the plant is smaller and the leaf-blades shorter and broader.

UTAH: Marvin Laccelite, 1894, *M. E. Jones 5663* (type, in U. S. Nat. Herb.).

Phacelia crenulata Torr., *P. bicolor* Torr., *P. affinis* A. Gray, *P. glechomaefolia* A. Gray, *P. hispida* A. Gray, *P. humilis* T. & G., *P. demissa* A. Gray, *P. Palmeri* Torr. (not *P. Palmeri* Vasey & Rose), *P. pinetorum* Jones, and *P. pusilla* Torr. have been collected in Utah; *P. glandulifera* Piper and *P. ramosissima* Dougl., in Idaho. I cannot distinguish *P. luteopurpurea* A. Nels. from *P. glandulifera* Piper. *Capnorea incana* Greene, *C. nana* (Lindl.) Raf., *C. nervosa* Greene, and *C. Watsoniana* Greene have been collected in Idaho; the first one also in Montana and the last one in Wyoming; *Emmenanthe penduliflora* Benth. and *Eriodictyon angustifolium* Nutt. in Utah.

BORAGINACEAE

Gruvelia setosa (A. Gray) Rydb.

Pectocarya setosa A. Gray, Proc. Am. Acad. **12**: 81. 1877.

I think that the genus *Gruvelia* A. DC. should be restored, being quite distinct from *Pectocarya*. The only other species is *G. pusilla* A. DC., the type of the genus.

Professor Nelson both in the original diagnosis* and in Coulter & Nelson's New Manual† described *Lappula erecta* as having the marginal prickles in a single row, but a duplicate of the type in the Columbia University herbarium and all specimens distributed as *Lappula erecta* by Professor Nelson himself in the herbarium of the New York Botanical Garden have a double row of marginal prickles, the prickles of the outer row being somewhat smaller than those of the inner.

Oreocarya pustulosa Rydb. sp. nov.

Perennial, branched at the base; stems 3–5 dm. high, glabrous or nearly so throughout, lower leaves linear-oblanceolate, the upper linear or linear-lanceolate, 3–10 cm. long, green, glabrous beneath, sparingly hairy above; the hairs short and at least in age with conspicuous pustulate bases; flowers paniculate; branches racemose, not secund; pedicels 1–2 mm. long; sepals triangular-lanceolate, acute; corolla white; tube not exceeding the calyx; limb 5–6 mm. broad; lobes orbicular; fruit depressed-globose; nutlets smooth, nearly white, mottled with light brown, more or less separated from each other on the margins, often not all maturing.

This is related to *Oreocarya multicaulis* (Torr.) Greene, *O. suffruticosa* (Torr.) Greene and the Mexican *O. Palmeri* Greene. It differs from the first two in the glabrous stem, green leaves, and light nutlets, and from *O. Palmeri* in broader leaves and different habit. It grows in canyons at an altitude of 1,700–2,000 m.

UTAH: Hammond Canyon, Elk Mountains, July 31, 1911, *Rydberg & Garrett 9320* (type, in herb. N. Y. Bot. Gard.); also same locality, Aug. 9, 1911, *9569;* Dry Wash, southwest of Abajo Mountains, August 10, *9590*.

Oreocarya Macounii Eastw. sp. nov.

Biennial or perennial with a slender tap-root; stem slender, 1–2 dm. high, sparingly hirsute; leaves narrowly linear or narrowly linear-oblanceolate, sparingly hirsute; inflorescence racemiform with short branches; corolla white, 5 mm. long, 4 mm. wide; nutlets ovate, obtuse, 2 mm. long, acutely margined, rounded on the back and coarsely muricate.

SASKATCHEWAN: Moose Mountain Creek, July 6, 1880, *John*

* Bull. Torrey Club **27**: 268. 1900.

† 412. 1909.

Macoun; also a specimen from Hooker's herbarium without date, probably collected by Richardson, at Carlton House. (Both in herb. Columbia University.)

Cryptanthe flexuosa A. Nelson is, I think, the same as *C. calycosa* (A. Gray) Rydb., and *C. muriculata montana* A. Nels. should be referred to *C. ambigua* (A. Gray) Greene, and *C. Hillmani* A. Nels. to *C. Watsoni* (A. Gray) Greene. *C. flaccida* (A. Gray) Greene has been collected in Idaho; *C. recurvata* Coville, in Utah and Colorado.

Mertensia coriacea A. Nels. is the same as *M. lanceolata* Pursh. Professor Nelson gives the range of *M. lanceolata* as Colorado and Wyoming. The type came from western Montana. *M. perplexa* is not the same as *M. coriacea*, as stated by Professor Nelson, but belongs to the *M. alpina* group with subsessile anthers.

Anchusa officinalis L. and *Asperugo procumbens* L. have been collected in Colorado; *Plagiobotrys arizonicus* (Gray) Greene in Utah; *P. tenellus* A. Gray in Idaho; *Cynoglossum officinale* L. in Wyoming and Montana; *Eremocarya muricata* Rydb. in Utah; *Lithospermum arvense* L. in Utah; *Mertensia brachycalyx* Piper in Idaho; *M. pulchella* Piper, *M. nutans* Howell, and *M. longiflora* Greene in Idaho and Montana; *Amsinckia hispidissima* Suksd., *A. retrorsa* Suksd. and *A. micrantha* Suksd. have been collected in Idaho.

Pectocarya miser A. Nels. I can not distinguish from *P. penicillata* (H. & A.) A. DC. *Eddya hispidissima* Torrey has been collected in Utah.

VERBENACEAE

Verbena remota Benth. was collected in southeastern Utah in 1911 by Professor Garrett and myself. *Verbena bipinnatifida* Nutt. is very rare in the region and *V. canadensis* (L.) Britton does not occur at all. The range given in Coulter & Nelson's New Manual is erroneous. The group is represented in the Rocky Mountains by *V. ambrosifolia* Rydb., *V. Gooddingii* Briq., and *V. ciliata* Benth.

LAMIACEAE

Lamium amplexicaule L. has been collected in Colorado; *Micromeria Douglasii* Benth. and *Trichostoma oblongum* Benth., in Idaho.

Monarda Nuttallii A. Nels. or *M. citriodora* of Coulter's Manual is *Monarda pectinata* Nutt.

Salvia Columbariae Benth. has been collected in Utah.

SCROPHULARIACEAE

Miss Eastwood has called to my attention that *Pentstemon acuminatus*, *P. humilis* Nutt., and *P. glaucus* Graham have been misinterpreted. *P. acuminatus* is a species confined to the Columbia Valley, has a more ample corolla, perfectly glabrous within; the tongue of the sterile filament is strongly curved and only short-bearded at the apex. Whether the so-called *P. acuminatus* of the Rocky Mountain region is a distinct species or should be included in *P. nitidus* Dougl. is hard to tell. A duplicate of the type of the latter is in the Columbia University herbarium, but this, as well as several other specimens, does not have the broad, abruptly acuminate bracts, characteristic of the so-called *P. acuminatus*, but there is no other distinction and intermediate forms are not lacking.

The original *P. humilis* Nutt. is, according to Miss Eastwood, the same as *P. collinus* A. Nels., which therefore passes into synonymy. Dr. Gray in describing *P. humilis** makes Nuttall's plant the type, but evidently had another plant mostly in his mind, viz. *Parry 257* and from this we have received our usual idea of *P. humilis*. This probably should be known as *P. albertinus* Greene,† which apparently is the same. Professor Nelson gives *P. pseudohumilis* Rydb. as a synonym, but this is the same as his own *P. Owenii*.

Pentstemon glaucus Graham does not belong to the group where Dr. Gray placed it and has nothing to do with the Rocky Mountain plant *P. stenosepalus* (Gray) Howell (*P. glaucus stenosepalus* A. Gray), but belongs to the *P. confertus* group. It is evidently the same as *P. pinetorum* Piper or closely related to it.

Pentstemon Macbridei A. Nels.‡ and *P. perpulcher* A. Nels. are apparently *P. Cusickii* A. Gray and *P. unilateralis* Rydb., respectively. A duplicate of the type of *P. Cusickii* is in the herbarium

* Proc. Am. Acad. **6**: 69. 1862.

† Leaflets **1**: 167. 1906.

‡ Bot. Gaz. **52**: 272, 273. 1911.

of Columbia University. The type of *P. unilateralis* is in that of the New York Botanical Garden. Recently botanists have overlooked the fact that in *P. speciosus* the anthers are perfectly glabrous and not short-bearded as in *P. glaber*. Dr. Gray overlooked the fact that *Pentstemon humilis* Nuttall is a member of the *P. erianthera* group and closely related to *P. miser* A. Gray, and placed it near *P. caespitosus* Nutt. Gray's two varieties of *P. humilis*, however, have nothing to do with it, and belong to the *P. caespitosus* group. The variety *Thompsoniae* has been already raised to specific rank and var. *incanus* is probably a form of it.

Pentstemon Leonardi Rydb. sp. nov.

Low perennial, suffruticose at the base; stems 1–2 dm. high, leafy, glabrous or minutely puberulent; leaves oblanceolate, 2–4 cm. long, short-petioled, glabrous; inflorescence short and often somewhat secund; calyx glabrous, about 6 mm. long; lobes lanceolate, acuminate, not scarious-margined; corolla 12–15 mm. long, rose-purple, only slightly ampliate, glabrous within; anthers horseshoe-shaped, saccate, opening only on the proximal one third, hispidulous on the margins of the pores, otherwise glabrous.

This belongs to the *P. azureus* group and has been confused with *P. Kingii*, but the leaves are broader and glabrous, the corolla less ampliate, the sepals not glandular and more acuminate. It differs from *P. platyphyllus* in the low habit and the smaller oblanceolate leaves.

UTAH: Diehl's Grove, Wahsatch Mountains, Aug. 1, 1884, *Leonard* (type, in herb. N. Y. Bot. Gard.); Deer Creek, *M. E. Jones;* Wahsatch Mountains, July, 1888, *J. H. Paul;* Central Utah 1875, *Parry 72*.

IDAHO: Franklin Basin, Bear River Range, July 24, 1910, *C. P. Smith 2278*.

Mimulus Eastwoodiae Rydb. sp. nov.

Mimulus cardinalis Eastw. Bull. Calif. Acad. II. **6**: 312. 1896. Not *M. cardinalis* Dougl. 1842.

Perennial, with rootstock and stolons; stem 1–2 dm. long, viscid-villous; leaves sessile, coarsely dentate, viscid-villous, 3–5-ribbed, sessile, 2–5 cm. long, the lower cuneate and truncate, the upper obovate or broadly oblanceolate and acute; stolons 1–3 cm. long, rooting at the end and nodes; their leaves less than 1 cm.

long; flowers mostly solitary; pedicels 1–4 cm. long; calyx narrowly funnelform, strongly 5-angled; lobes nearly equal, lanceolate, about half as long as the tube; corolla crimson, 3–4 cm. long, scarcely ventricose; anthers sparingly bearded.

This is related to *Mimulus cardinalis*, to which Miss Eastwood referred it with some hesitation. She also pointed out the low habit and more sharply toothed leaves, but did not notice the most striking feature of the plant, viz., its stolons, which are sent out after blooming. By means of these the plant, growing as it does in crevices of perpendicular or overhanging cliffs, can propagate itself in every direction. Wherever a stolon touches the rock and the root can get a foothold, a new plant is formed, even under the overhanging rocks. In the latter case the plantlet formed will be growing, the following year, with the roots up and the flowers down.

UTAH: In cervices of perpendicular or overhanging rocks, along San Juan River, near Bluffs, August 25–29, 1911, *Rydberg 9883* (type); also the same locality, *Miss Eastwood*.

Veronica Buxbaumii Tenore has been collected in Utah and *V. arvensis* L. in Idaho. *Veronica peregrina* L. is not found in the Rocky Mountain region. All specimens so named from there belong to *V. xalapensis* H. B. K. *Antirrhinum Cooperi* A. Gray and *A. Kingii* S. Wats. have both been collected in Utah; *Monniera rotundifolia* Michx. in Montana; *Gratiola ebracteata* Benth. in Montana and Idaho.

Triphysaria hispida (Benth.) Rydb.

Orthocarpus hispidus Benth. Scroph. Ind. 13. 1835.

In the genus *Cordylanthus* [*Adenostegia*] Coulter & Nelson* have transposed the color characters of the corolla of *C. Wrightii* and *C. ramosa*. *Adenostegia capitata* (Nutt.) Greene has been collected in Idaho and *A. canescens* is common around Great Salt Lake. *Cordylanthus bicolor* A. Nels. is evidently the same as *Adenostegia ciliosa* Rydb.

Castilleja subcinerea Rydb. sp. nov.

Perennial with a branched short caudex; stems 3–5 dm. high, canescent-strigose, stout; leaves more or less canescent, strongly

* See Manual 462. 1909.

3-ribbed, 5–7 cm. long, the lowest entire, linear, the upper 3-cleft; bracts broadly cuneate in outline, 5–7-cleft, canescent, the lower grayish green, the upper tinged with yellow and often brown-tipped; calyx canescent, 2.5 cm. long, equally cleft above and below, each lobe 2-cleft; corolla greenish yellow; upper lip 9 mm. long; the lower about 3.5 mm. long, slightly saccate.

It may be related to the *C. hispida* group, but the plant is grayish strigose, and the bracts yellow-tinged.

IDAHO: Beaver Canyon, June 28, 1895, *C. L. Shear 3041* (type, in herb. N. Y. Bot. Gard.); also *3038;* mountains near Indian Creek, July 21, 1897, *Rydberg & Bessey 4969* (at least in part).

Euphrasia mollis (Ledeb.) Wettst. has been collected in Montana; *Pedicularis lanata* Willd. and *P. flammea* L. in the Canadian Rockies; *P. Oederi* Vahl in Montana and *P. centranthera* A. Gray in Utah and Colorado.

OROBANCHACEAE

Thalesia purpurea Heller, *T. minuta* (Suskd.) Rydb. and *T. Sedi* (Suksd.) Rydb. have been collected in Montana and northern Idaho, and *Myzorrhiza pinetorum* (Geyer) Rydb. in Idaho.

LOBELIACEAE

Howellia aquatilis A. Gray and *Heterocodon rariflorum* Nutt. have been collected in Idaho and *Nemacladus ramosissimus* Nutt. in south Utah.

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WEST INDIAN MOSSES—I

By ELIZABETH GERTRUDE BRITTON

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West Indian mosses—I

ELIZABETH GERTRUDE BRITTON

(WITH PLATE 25)

A. WEST INDIAN MOSSES KNOWN TO LINNAEUS

In Linnaeus' Species Plantarum* 8 genera† and 103 species of mosses are recognized, of which only 2 are known to be tropical American in their distribution, ranging from southern Florida to South America. The first of these tropical species is *Bryum albidum* L. (p. 1118) known to Dillenius‡ as *Bryum nanum*, lariginis foliis albis, and now known as *Octoblepharum albidum* (L.) Hedw., with the type locality on the island of New Providence in the Bahamas.

The other species, *Rhizogonium spiniforme* (L.) Bruch was the first species of *Hypnum* named by Linnaeus and it also was based on a Dillenian description and plate.§ He called it "the *Herring's-Bone Hypnum*" and his specimens were sent to him from Mt. Diabolo, Jamaica, by Sir Hans Sloane. Its range through the tropics is even wider than that of *Octoblepharum*, including the Islands of the Pacific; both species are known to occur not only throughout the American tropics but also in Asia and Africa.

* 1106-1130. 1753.

† 1. *Sphagnum*	2	5. *Polytrichum*	3
2. *Phascum*	3	6. *Mnium*	18
3. *Fontinalis*	4	7. *Bryum*	30
4. *Splachnum*	3	8. *Hypnum*	40
			103

‡ Historia Muscorum 364. *pl. 46. f. 21.* 1741.

§ Historia Muscorum 332. *pl. 43. f. 68.* 1741.

[The BULLETIN for November (40: 599–652. *portrait*) was issued 24 N 1913.]

1. OCTOBLEPHARUM ALBIDUM (L.) Hedw. Descr. **3**: 15. 1791
Bryum albidum L. Sp. Pl. 1118. 1753.

TYPE LOCALITY: New Providence, Bahamas.

DISTRIBUTION: Florida and the Bahamas, throughout the West Indies: in Cuba, Jamaica, Haiti and St. Domingo, Porto Rico, Dominica, St. Thomas, St. Kitts, Montserrat, Guadeloupe, Martinique, St. Lucia, Grenada to Trinidad; also in South America and tropical regions of Africa and Asia.

ILLUSTRATIONS: Dill. Hist. Musc. *pl. 46. f. 21;* Hedw. Descr. **3**: *pl. 6A;* Card. Rech. Anat. Leuc. *pl. 12. f. 61.*

EXSICCATAE: Sull. Musci Cub. Wright. *55.* 1861; Husnot, Pl. Ant. Fr. *121.* 1868; Austin, Musci App. Suppl. *478.* 1874; Ren. & Card. Musci Am. Sept. Exsicc. *213;* Holz. Musci Acroc. Bor. Am. *57;* Small, Mosses S. U. S. *52.*

2. RHIZOGONIUM SPINIFORME (L.) Bruch, Flora **29**: 134. 1846
Hypnum spinaeforme L. Sp. Pl. 1122. 1753.
Mnium spiniforme C. Müll. Syn **1**: 175. 1849.

TYPE LOCALITY: Mt. Diabolo, Jamaica, *Hans Sloane.*

DISTRIBUTION: In wet woods, in tropical regions of all portions of the world. Southern United States: Georgia, Alabama, Louisiana, Florida; Jamaica, Cuba, Haiti, Porto Rico, Guadeloupe to S. America; Mexico, Guatemala, Costa Rica, and Panama.

ILLUSTRATIONS: Sloane, Hist. Jam. *pl. 25. f. 4.* 1707; Dill. Hist. Musc. 332. *pl. 43. f. 8.* 1741.

EXSICCATAE: Sull. Musci Cub. Wright. *58.* 1861; Husnot, Pl. Ant. Fr. *152.* 1868; Austin, Musci App. Suppl. *516.* 1874; Ren. & Card. Musci Am. Sept. Exs. *64;* Holz. Musc. Acroc. Bor. Am. *174;* Pringle, Musci Mex. *10482.*

Another of the Linnaean species, *Hypnum cuspidatum* L., has been found in the high mountains of Jamaica. *Pogonatum urnigerum* L. Sp. Pl. 1109. 1753, was also credited to Jamaica, following Dillenius, who quotes Hans Sloane's History of Jamaica and mistook his *f. 5, pl. 25,* for this European species. *F. 4* of the same plate is unmistakable for *Rhizogonium spiniforme.*

B. WEST INDIAN MOSSES KNOWN TO OLOF SWARTZ

In his Prodromus, Swartz* retained 5 of the generic names

* Olof Swartz, Nova Genera & Species Plantarum seu Prodromus, etc. 138–142. 1788.

used by Linnaeus* and enumerated 41 species, which as at present recognized belong to 37 different genera, three of these having their type localities in Hispaniola (Haiti and Santo Domingo), all the rest in Jamaica.

In studying the collections made by Mr. Wm. Harris in Jamaica and our own later collections, a special effort has been made to obtain an accurate knowledge of these Swartz types and Dr. A. Le Roy Andrews, of Cornell University, very kindly consented, when he visited Stockholm in the summer of 1912, to examine these types for me and compare them with specimens from our own collections in Jamaica, sent as duplicates to the Naturhistoriska Riksmuseum. Dr. Andrews was able to see and compare the original specimens with ours in all but two cases: *Bryum parasiticum* Sw. [= *Syrrhopodon parasiticus* (Sw.) Besch.] and *Hypnum congestum* Sw. [= *Pleuropus congestus* (Sw.) Broth.], which species we have not yet been able to recognize, the former being from Hispaniola and the type lacking in Swartz' herbarium, the latter from Jamaica and Haiti. We suspect from the illustration given by Hedwig that the latter is probably referable to *Palamocladium Bonplandi* (Hook.) Broth., which Brotherus later refers to *Pleuropus*, though he states that he has not seen specimens of *Pleuropus congestus*.

In 1806 Swartz discarded his Linnaean limitations† and adopted some of the generic changes proposed by Hedwig (1792), to whom he sent specimens of most of his West Indian mosses, from which almost all of Hedwig's plates were drawn. This eliminated *Fontinalis* and *Mnium* from the West Indies and added seven genera‡ and three species to the list given in the Prodromus; he further amplified his list by giving more in detail the stations and habitats. These are translated and quoted in the following list of species in the sequence enumerated by Swartz, with their modern names, synonyms, and distribution as at present known to us from the West Indies:

* *Fontinalis*, *Polytrichum*, *Mnium*, *Bryum*, and *Hypnum*.

† Fl. Ind. Occ. 3: 1759–1841. 1806.

‡ *Encalypta*, *Trichostomum*, *Tortula*, *Dicranum*, *Pterogonium*, *Neckera*, and *Leskea*.

1. **Neckera jamaicense** (Gmel.) E. G. Britton, comb. nov.

Fontinalis crispa Sw. Prod. 138. 1788. Not *Hypnum crispum* L. Sp. Pl. 1124. 1753.

Hypnum jamaicense Gmel. Syst. Nat. **2**: 1341. 1791.

Neckera undulata Hedw. Descr. **3**: 51. 1792.

Neckera undulata Hedw.; Sw. Fl. Ind. Occ. **3**: 1780. 1806.

Neckeropsis undulata Kindb. Eu. & N. A. Bryin. **1**: 20. 1897.

HABITAT AND TYPE LOCALITY: "On trunks of trees in dense low woods, Jamaica."

DISTRIBUTION: Not uncommon on trees from Florida and the Greater and Lesser Antilles to Trinidad; Mexico, Guatemala, and Panama; also in South America.

ILLUSTRATIONS: Dill. Hist. Musc. 294. *pl. 32. f. 8;* Hedw. Descr. *pl. 21* (from Swartz' type).

EXSICCATAE: Austin, Musci App. Suppl. *529;* Sull. Musci Cub. Wright. *75;* Husnot, Pl. Ant. Fr. *155;* Grout, N. A. Musci Pleur. *230*.

2. NECKERA DISTICHA (Sw.) Hedw. Descr. **3**: 53. 1792

Fontinalis disticha Sw. Prod. 138. 1788.

Neckera disticha Hedw. Descr. **3**: 53. 1792.

Neckera disticha Sw. Fl. Ind. Occ. **3**: 1784. 1806.

Neckeropsis disticha Kindb. Eu. & N. A. Bryin. **1**: 20. 1897.

HABITAT AND TYPE LOCALITY: On trunks of trees, Jamaica and Hispaniola.

DISTRIBUTION: Less common, on trees. Florida and the Greater and Lesser Antilles to South America; in Central America from Mexico to Panama; also in Africa.

ILLUSTRATION: Hedw. Descr. *pl. 22* (from Swartz' type).

EXSICCATAE: Austin, Musci App. Suppl. *530*.

3 PTEROBRYUM FILICINUM (Sw.) Mitt. Jour. Linn. Soc. **12**: 425. 1869

Fontinalis filicina Sw. Prod. 138. 1788.

Neckera filicina Hedw. Descr. **3**: 45. 1792.

Pilotrichum filicinum P. Beauv. Prod. 83. 1805.

Neckera filicina Sw. Fl. Ind. Occ. **3**: 1788. 1806.

Pireella filicina Cardot, Rev. Bryol. **40**: 18. 1913.

HABITAT AND TYPE LOCALITY: "Near Coldspring, high mountains of southern Jamaica, on trunks of trees."

DISTRIBUTION: Jamaica and Cuba.

ILLUSTRATION: Hedw. Descr. *pl. 18* (from Swartz' type).

EXSICCATAE: Sull. Musci Cub. Wright. *76*.

This species has immersed capsules and seems to belong where Mitten has placed it.

4. PILOTRICHUM HYPNOIDES (Sw.) P. Beauv. Prod. 83. 1805

Fontinalis hypnoides Sw. Prod. 138. 1788.
Neckera hypnoidea Hedw. Descr. 3: 43. 1792.
Neckera hypnoides Sw. Fl. Ind. Occ. 3: 1790. 1806.

HABITAT AND TYPE LOCALITY: "Jamaica, on trunks of trees in high mountains."

DISTRIBUTION: Jamaica to Trinidad.

ILLUSTRATION: Hedw. Descr. *pl. 17* (from Swartz' type).

5. CRYPHAEA FILIFORMIS (Sw.) Brid. Bryol. Univ. 2: 251. 1827

Fontinalis filiformis Sw. Prod. 138. 1788.
Neckera filiformis Hedw. Descr. 3: 41. 1792.
Neckera filiformis Sw. Fl. Ind. Occ. 3: 1786. 1806.

HABITAT AND TYPE LOCALITY: "Hispaniola, in arid regions on branches of *Haematoxylon campechianum*."

DISTRIBUTION: Jamaica, Cuba, and Santo Domingo; also in South America, Central America and Mexico (Guatemala and Yucatan).

ILLUSTRATION: Hedw. Descr. *pl. 16* (from Swartz' type).

EXSICCATAE: Sull. Musci Cub. Wright. *67*.

6. POGONATUM TORTILE (Sw.) Brid. Bryol. Univ. 2: 108. 1827

Polytrichum convolutum Sw. Prod. 139. 1788. Not L. 1753.
Polytrichum convolutum Hedw. Sp. Musc. 94. 1801.
Pogonatum convolutum Beauv. Prod. 85. 1805.
Polytrichum tortile Sw. Fl. Ind. Occ. 3: 1839. 1806.
Polytrichum domingense Brid. Mant. 201. 1819.
Polytrichum cubense Sull. Proc. Am. Acad. 5: 281. 1861.
Polytrichum glaucinum Besch. Ann. Sci. Nat. VI. 3: 210. 1876.
Polytrichum Husnotianum Besch. l. c.
Polytrichum crispulum Besch. l. c. 211.

Polytrichum laxifolium Besch. l. c. 211.
Polytrichum Pleeanum Besch. l. c. 212.
Polytrichum Sintenisii C. Müll. Hedwigia **37**: 222. 1898.
Polytrichum (*Catharinella*) *obscuro-viridis* C. Müll. Hedwigia **37**: 223. 1898.

HABITAT AND TYPE LOCALITY: "On clay banks, high mountains of southern Jamaica."

DISTRIBUTION: Cuba, Jamaica, Haiti, Porto Rico, Guadeloupe, Martinique, Dominica, Grenada, and Barbados.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 20.*

EXSICCATAE: Sull. Musci Cub. Wright. *57;* Husnot, Pl. Ant. Fr. *153*.

This species varies greatly according to habitat, whether dry or wet, sunny or shady. It usually grows on roadside banks of the hard red clay, on the dry or southern sides of the West Indian islands and under such conditions, does not attain the lax, long leaves that are produced in shady moist valleys. Microscopic sections of the leaves show the lamellae to be somewhat variable but all of one generally uniform character, and though the serrations of the margins are more or less variable, the teeth being at times appressed and at others spreading, we find no constant differences between them. The presence of teeth on the back of the costa is just as true of *P. tortile* Sw. as of *P. glaucinum* Besch.

7. BREUTELIA TOMENTOSA (Sw.) Sch. "In Hb." Paris, Index Bryol. **1**: ed. 2. 173. 1904

Mnium tomentosum Sw. Prod. 139. 1788.
Bryum tomentosum Sw. Fl. Ind. Occ. **3**: 1837. 1806.
Bartramia macrocarpa Hampe, Linnaea **32**: 141. 1863.
Bartramia macrotheca Hampe, Ann. Sci. Nat. V. **3**: 373. 1866.
Breutelia macrotheca Jaeg. Adumb. **1**: 556. 1873–74.

HABITAT AND TYPE LOCALITY: "On the edge of woods high mountains of Jamaica."

DISTRIBUTION: Jamaica and Guadeloupe to South America; also Mexico and Costa Rica.

ILLUSTRATIONS: Hooker, Musci Exot. *pl. 19.* 1818. From original specimen of Swartz. E. & P. Nat. Pfl. $\mathbf{1}^3$: 656. *f. 498.* 1904.

8. PHILONOTIS SPHAERICARPA (Sw.) Brid. Bryol. Univ. **2**: 25. 1827

Mnium sphaericarpon Sw. Prod. 139. 1788.
Mnium sphaericarpum Hedw. Descr. **3**: 93. 1792.
Bryum sphaericarpon Sw. Fl. Ind. Occ. **3**: 1835. 1806.
Bartramia sphaericarpa Mitt. Jour. Linn. Soc. **12**: 261. 1869.

HABITAT AND TYPE LOCALITY: "In shady mossy places, summits of mountains of southern Jamaica."

DISTRIBUTION: Florida, Jamaica, Porto Rico, St. Thomas, St. Kitts, St. Vincent, Martinique, and Guadeloupe; Honduras to South America.

ILLUSTRATION: Hedw. Descr. **3**: *pl. 38A*.

9. DITRICHUM RUFESCENS (Hampe) Broth. in E. & P. Nat. Pfl. 1^3: 300. 1901

Mnium strictum Sw. Prodr. 139. 1788. Not *Ditrichum strictum* Hampe. 1867.
Trichostomum strictum Sw. Fl. Ind. Occ. **3**: 1761. 1806.
Trichostomum pallidum strictum Schwaegr. Suppl. 2^1: 77. 1823.
Leptotrichum rufescens Hampe, Linnaea **31**: 521. 1862.
Cynontodium strictum Mitt. Jour. Linn. Soc. **12**: 42. 1869.
Cynontodium rufescens Mitt. Jour. Linn. Soc. **12**: 44. 1869.
Leptotrichum mexicanum Sch.; Besch. Mém. Soc. Sci. Nat. Cherbourg **16**: 174. 1872.
Leptotrichum capillifolium Sch.; Jaeg. Adumb. **1**: 388. 1871–72.
Leptotrichum pseudo-rufescens C. Müll. Bull. Herb. Boiss. **5**: 554. 1897.

HABITAT AND TYPE LOCALITY: "Jamaica, on shady slopes in sandy wet soil among other mosses, cold places."

DISTRIBUTION: Jamaica, 1,500–2,100 meters. Also, Mexico to Colombia.

ILLUSTRATION: Schwaegr. Suppl. *pl. 123*.

10. TORTULA AGRARIA (Sw.) Sw. Fl. Ind. Occ. **3**: 1763. 1806

Bryum agrarium Sw. Prod. 139. 1788.
Bryum acuminatum Sw. Prod. 139. 1788.
Barbula agraria Hedw. Descr. **3**: 17. 1792.
Barbula Raui Aust. Bull. Torrey Club **6**: 43. 1875.

HABITAT AND TYPE LOCALITY: "Jamaica and Hispaniola, in sugar fields and on calcareous rocks."

DISTRIBUTION: Florida and Texas. Common in the Bahamas on limestone rocks, whence it was known to Dillenius. Jamaica, Cuba, Porto Rico, Guadeloupe, Antigua, Montserrat to Trinidad and South America; also in Mexico.

ILLUSTRATION: Hedw. Descr. *pl. 6B*, from original specimens collected by Swartz in Jamaica and Santo Domingo.

11. BRYUM ACUMINATUM Sw. Prod. 139. 1788.
(See 10)

12. SYRRHOPODON LYCOPODIOIDES (Sw.) C. Müll. Syn. **1**: 538. 1849

Bryum lycopodioides Sw. Prod. 139. 1788.
Dicranum? lycopodioides Sw. Fl. Ind. Occ. **3**: 1766. 1806.

HABITAT AND TYPE LOCALITY: "Jamaica; in moist shady woods, on high mountains."

DISTRIBUTION: Jamaica, Santo Domingo, Haiti, Porto Rico, Guadeloupe, and Martinique to Trinidad.

EXSICCATAE: Husnot, Pl. Ant. Fr. *151*.

13. SYRRHOPODON PARASITICUS Besch. Ann. Sci. Nat. VIII. **1**: 298. 1895

Bryum parasiticum Sw. Prod. 139. 1788.
Encalypta parasitica Sw. Fl. Ind. Occ. **3**: 1759. 1806.
Calymperes parasitica Hook. & Grev. Edinb. Jour. Sci. **1**: 131. 1824.

The type cannot be found at Stockholm in Swartz' herbarium. A fragment of the type specimen exists at Kew, and Mitten had only two leaves of it. He states that it is very close to *Calymperes Richardi* but the illustration given by Schwaegrichen of the calyptra and the description given by Swartz, "*Calyptra longa subulata, non laxa, pallida, ore aequali, latere demum fissili*" disprove this, and it is evident, either that Schwaegrichen was mistaken in figuring a calyptra which resembles that of a *Macromitrium* or it is a species of that genus, which is very common in Jamaica. Mitten referred a specimen collected by R. Spruce in South America (no. 2) to this species but that proves to be a true *Calymperes*.

The duplicate type from which Schwaegrichen's plate was drawn has been loaned to us from Geneva and corresponds with all of this plate except the calyptra, which is lacking; but the hyaline basal cells are not clearly indicated. It is evidently a species of *Syrrhopodon* with entire leaf margins bordered by elongated cells and does not agree with any known to us thus far from the West Indies.

HABITAT AND TYPE LOCALITY: Hispaniola. "On branches of *Haematoxylon* and *Mimosa Unguis-cati*."

DISTRIBUTION: Known only from the original collection.

ILLUSTRATION: Schwaegr. Suppl. **1**: 60. *pl. 17*. 1811.

14. HOLOMITRIUM CALYCINUM (Sw.) Mitt. Jour. Linn. Soc. **12**: 60. 1869

Bryum calcycinum Sw. Prod. 139. 1788.
Weisia calycina Hedw. Sp. Musc. 70. 1801.
Cecalyphum? calicinum Beauv. Prod. Aetheog. 50. 1805.
Dicranum calycinum Sw. Fl. Ind. Occ. **3**: 1768. 1806.

HABITAT AND TYPE LOCALITY: "On roots of trees in high mountains. Jamaica."

DISTRIBUTION: Known only from Jamaica.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 14. f. 1–5*.

15. FISSIDENS PALMATUS (Sw.) Hedw. Descr. **3**: 69. 1792

Hypnum palmatum Sw. Prod. 140. 1788.
Dicranum palmatum Sw. Fl. Ind. Occ. **3**: 1774. 1806.
Skitophyllum palmatum De la Pyl. Jour. de Bot. II. **4**: 146. 1814.

HABITAT AND TYPE LOCALITY: "In shady clayey places at roots of palms. Jamaica. Collected also on high trunk of *Areca oleracea*, in a cavity filled with rotten leaves."

DISTRIBUTION: Jamaica, Cuba, and St. Thomas.

ILLUSTRATIONS: Hedw. Descr. *pl. 30A*. 1792 (from Swartz' type); De la Pyl. Jour. de Bot. *pl. 35. f. 6*. 1814.

EXSICCATAE: Sull. Musci Cub. Wright. *11*.

16. FISSIDENS POLYPODIOIDES (Sw.) Hedw. Descr. **3**: 63. 1792

Hypnum polypodioides Sw. Prod. 140. 1788.
Dicranum polypodioides Sw. Fl. Ind. Occ. **3**: 1772. 1806.
Skitophyllum polypodioides De la Pyl. Jour. de Bot. II. **3**: 153. 1814.

HABITAT AND TYPE LOCALITY: "On the ground in shady mossy slopes in high mountains, Jamaica."

DISTRIBUTION: Georgia, Alabama, Florida, and Louisiana; Jamaica, Cuba, Haiti, Porto Rico; Dominica, Guadeloupe, and Martinique, to South America; also, Mexico, Guatemala, and Panama.

ILLUSTRATIONS: Sull. Icon. Musc. *pl. 27;* De la Pyl. l. c. *pl. 38. f. 10.*

EXSICCATAE: Drummond, Musci Am. ed. 2. *38;* Sull. & Lesq. Musci Bor. Am. ed. 2. *87*: Sull. Musci Cub. Wright. *10;* Small, Mosses So. U. S. *9;* Husnot, Pl. Ant. Fr. *133*.

17. FISSIDENS ASPLENIOIDES (Sw.) Hedw. Descr. **3**: 65. 1792

Hypnum asplenioides Sw. Prod. 140. 1788.

Dicranum asplenioides Sw. Fl. Ind. Occ. **3**: 1770. 1806.

Skitophyllum asplenioides De la Pyl. Jour. de Bot. II. **4**: 156. 1814.

Fissidens Barbae-montis C. Müll.; Ren. & Card. Bull. Soc. Roy. Bot. Belg. **31**[1]: 152. 1892.

Fissidens costaricensis Besch. Bull. Herb. Boiss. **2**: 390. 1894.

HABITAT AND TYPE LOCALITY: "On mossy rocks in high mountains of Jamaica."

DISTRIBUTION: Jamaica and St. Kitts; also Mexico and Costa Rica.

ILLUSTRATIONS: Hedw. Descr. *pl. 28* (from type); De la Pyl. Jour. de Bot. II. **4**: *pl. 38. f. 8, 9.*

EXSICCATAE: Pringle, Musci Mex. *10,503*.

18. PHYLLOGONIUM FULGENS (Sw.) Brid. Bryol. Univ. **2**: 671. 1827

Hypnum fulgens Sw. Prod. 140. 1788.

Pterigynandrum fulgens Hedw. Descr. **4**: 101. 1797.

Pterogonium fulgens Sw. Fl. Ind. Occ. **3**: 1776. 1806.

? *Phyllogonium viride* Brid. Bryol. Univ. **2**: 673. 1827.

Phyllogonium aureum Mitt. Journ. Linn. Soc. **12**: 424. 1869.

Phyllogonium globitheca C. Müll. Bull. Herb. Boiss. **5**: 563. 1897.

HABITAT AND TYPE LOCALITY: "Dependent from branches of trees in high mountains of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, Porto Rico, St. Kitts, Antigua, Montserrat, Guadeloupe, Martinique, St. Vincent, and Grenada to Trinidad. Also in South America.

ILLUSTRATION: Hedw. Descr. *pl. 39* (from type).

EXSICCATAE: Sull. Musci Cub. Wright. *131;* Husnot, Pl. Ant. Fr. *154.*

There is some doubt as to what the type specimen of *Phyllogonium viride* of Bridel is. The type locality is Brazil and it is just possible that the name may antedate either *P. immersum* Mitt. or *P. Serra* C. Müll. Both these species were distributed by E. Ule in his Bryotheca Brasiliensis no. 81 from Serra Geral, Province of Santa Catharina, Brazil. All the West Indian specimens, so-called, are referable to *P. fulgens.*

19. LEPIDOPILUM DIAPHANUM (Sw.) Mitt. Jour. Linn. Soc. **12:** 382. 1869

Hypnum diaphanum Sw. Prod. 140. 1788.
Hypnum diaphanum Hedw. Sp. Musc. 243. 1801.
Hypnum? diaphanum Sw. Fl. Ind. Occ. **3:** 1828. 1806.
Pterygophyllum diaphanum Brid. Bryol. Univ. **2:** 345. 1827.
Hookeria diaphana W.-Arn. Disp. Musc. 56. 1825.

HABITAT AND TYPE LOCALITY: "In depressions, mountains of Jamaica. Mixed with *Marchantia* and *Jungermannia.*"

DISTRIBUTION: Jamaica, Martinique.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 61. f. 1–6* (from type).

20. CYCLODICTYON ALBICANS (Sw.) Broth. in E. & P. Pfl. **1**^{3}: 935. 1907

Hypnum albicans Sw. Prod. 140. 1788.
Hypnum albens Gmel. Syst. Nat. **2:** 1343. 1791.
Leskea albicans Hedw. Sp. Musc. 218. 1801.
Leskea albicans Sw. Fl. Ind. Occ. **3:** 1811. 1806.
Hypnum pallidum Brid. Musc. Rec. **2**^{2}: 127. 1806.
Pterygophyllum albicans Brid. Bryol. Univ. **2:** 349. 1827.

HABITAT AND TYPE LOCALITY: "On old and rotten trunks of trees, temperate regions of Jamaica."

DISTRIBUTION: Jamaica, Guadeloupe, St. Vincent, and Mexico.

ILLUSTRATIONS: Hedw. Sp. Musc. 218. *pl. 54. f. 13–16* (from type).

EXSICCATAE: Pringle, Musci Mex. *10,664.*

21. HOMALIA GLABELLA (Sw.) Mitt. Jour. Linn. Soc. **12**: 458. 1869

Hypnum glabellum Sw. Prod. 140. 1788.
Leskea glabella Hedw. Sp. Musc. 235. 1801.
Neckera glabella Sw. Fl. Ind. Occ. 3: 1782. 1806.

HABITAT AND TYPE LOCALITY: "On trunks of trees in mountains of Jamaica."

DISTRIBUTION: Jamaica, Porto Rico, Guadeloupe, Mexico, Costa Rica, to Venezuela.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 59* (from type specimens).

22. METEORIOPSIS PATULA (Sw.) Broth. in E. & P. Pfl. **1**³: 825. 1906

Hypnum patulum Sw. Prod. 140. 1788.
Hypnum patulum Hedw. Sp. Musc. 279. 1801.
Hypnum? patulum Sw. Fl. Ind. Occ. 3: 1832. 1806.
Leskea remotifolia C. Müll. Linnaea **19**: 216. 1847.
Meteorium stellatum Lorentz, Moosst. 165. 1864.
Meteorium flaccidum Mitt. Jour. Linn. Soc. **12**: 443. 1869.
Meteorium tenue Sch. Besch. Mém. Soc. Sc. Nat. Cherbourg **16**: 227. 1872.
Meteorium diversifolium Besch. l. c.
Meteorium torticuspis C. Müll. Bull. Herb. Boiss. **5**: 204. 1897.

HABITAT AND TYPE LOCALITY: "On roots and branches of trees near the summits, mountains of Jamaica."

DISTRIBUTION: Florida, in hammocks near Cutler, *J. K. Small;* Jamaica, Haiti, Porto Rico, Guadeloupe, Martinique, Dominica, Montserrat, St. Vincent, Grenada, and Trinidad to South America; also Mexico, Guatemala, Honduras, Costa Rica, and Panama.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 73*.

EXSICCATAE: Sull. Musci Cub. Wright. *80;* Husnot, Pl. Ant. Fr. *168;* Pringle, Musci Mex. *15,136*.

This is a common and variable species in the tropics and accordingly has received a variety of names. There seems to be no reason for maintaining two sections and such a host of names in this genus, for according to Mitten and R. S. Williams the following also are synonyms of this species: *M. aureo-nitens* Hampe (not Hook.), *M. barbipendulum* C. Müll.; *M. cirrifolium* Schw., *M. chiriquense* Ltz., *M. Eurhynchium* C. Müll., *M. Filicis* C. Müll., and *M. subambiguum* (Hampe) Paris.

23. Mittenothamnium reptans (Sw.) Card. Rev. Bryol. **40**: 21. 1913

Hypnum reptans Sw. Prod. 140. 1788.
Hypnum reptans Hedw. Sp. Musc. 265. 1801.
Hypnum reptans Sw. Fl. Ind. Occ. 3: 1819. 1806.
Microthamnium reptans Mitt. Jour. Linn. Soc. **12**: 506. 1869.
Hypnum pseudo-reptans C. Müll. Bot. Zeit. **14**: 439. 1856.
Microthamnium Turckheimii C. Müll. Bull. Herb. Boiss. **5**: 215. 1897.
Microthamnium minusculum C. Müll. Bull. Herb. Boiss. **5**: 565. 1897.
Stereohypnum reptans Fleisch. Hedwigia **47**: 275. 1908.

Habitat and type locality: "On earth and trunks of trees, interior of Jamaica."

Distribution: Cuba, Jamaica, Guadeloupe, Martinique, Mexico, Guatemala, Nicaragua, Costa Rica, Panama, and South America.

Illustration: Hedw. Sp. Musc. *pl. 68.*

24. Porotrichum fasciculatum (Sw.) Mitt. Jour. Linn. Soc. **12**: 468. 1869

Hypnum fasciculatum Sw. Prod. 140. 1788.
Hypnum fasciculatum Hedw. Sp. Musc. 245. 1801.
Hypnum? fasciculatum Sw. Fl. Ind. Occ. **3**: 1827. 1806.
Thamnium fasciculatum C. Müll. Hedwigia **37**: 260. 1898.

Habitat and type locality: "On roots of trees; high mountains of Jamaica."

Distribution: Jamaica, Porto Rico, and Trinidad to South America.

Illustrations: Hedw. Sp. Musc. *pl. 62. f. 8–10* (from Swartz' specimens).

25. Hypopterygium Tamarisci (Sw.) Brid. Bryol. Univ. **2**: 715. 1827

Hypnum Tamarisci Sw. Prod. 141. 1788.
Leskea Tamariscina Hedw. Sp. Musc. 212. 1801.

Hypnum Tamarisci Sw. Fl. Ind. Occ. 3: 1825. 1806.
Hypopterygium brasiliense Sull. U. S. Expl. Exp. 26. 1859.
?*Hypopterygium pseudo-tamarisci* C. Müll. Linnaea 38: 645. 1874.

HABITAT AND TYPE LOCALITY: "On trunks of trees, creeping among mosses in the cold regions of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, and Porto Rico; also in Mexico, Guatemala, Costa Rica, and South America.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 62. f. 8–10;* Sull. U. S. Expl. Exped. *pl. 26.*

EXSICCATAE: Sull. Musci Cub. Wright. *130;* Pringle, Musci Mex. *10,497.*

26. PILOTRICHELLA FLEXILIS (Sw.) Jaeg. Adumb. 2: 162. 1875–76

Hypnum flexile Sw. Prod. 141. 1788.
Leskea flexilis Hedw. Sp. Musc. 234. 1801.
Hypnum? flexile Sw. Fl. Ind. Occ. 3: 1830. 1806.
Meteorium flexile Mitt. Jour. Linn. Soc. 12: 438. 1869.
Neckera cochlearifolia C. Müll. Syn. 2: 130. 1851.
Neckera turgescens C. Müll. Syn. 2: 131. 1851.
Pilotrichella eroso-mucronata C. Müll. Bull. Herb. Boiss. 5: 563. 1897.
Pilotrichella recurvo-mucronata C. Müll. Bull. Herb. Boiss. 5: 563. 1897.

HABITAT AND TYPE LOCALITY: "Summits of mountains in Southern Jamaica"

DISTRIBUTION: Jamaica, Cuba, Haiti, Porto Rico, Guadeloupe; Mexico, Guatemala, Nicaragua, Costa Rica, Panama; Colombia, Ecuador, Bolivia, and Brazil.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 58.*

EXSICCATAE: Pringle, Musci Mex. *10,420, 10,468,* Grout, N. A. Musci Pleur. *389.*

27. PAPILLARIA NIGRESCENS (Sw.) Jaeg. Adumb. 1: 169. 1875–76

Hypnum nigrescens Sw. Prod. 141. 1788.
Hypnum nigrescens Hedw. Sp. Musc. 250. 1801.
Pterogonium nigrescens Sw. Fl. Ind. Occ. 3: 1778. 1806.
Neckera nigrescens Schwaegr. Suppl. 3^2. 1828.

Meteorium nigrescens Mitt. Jour. Linn. Soc. **12**: 441. 1869.
Papillaria nigrescens Donnellii Aust. Musci App. Suppl. 14. 1898.

HABITAT AND TYPE LOCALITY: "On branches of trees, high mountains of Jamaica. Collected on *Anacardium occidentale*."

DISTRIBUTION: Louisiana, Florida, and the Bahamas; Jamaica, Cuba, Haiti, Porto Rico, Barbados, and Trinidad to South America; also in Lower California, Mexico, Guatemala, Costa Rica, and Panama. Also in South America.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 65*. 1801; Schwaegr. Suppl. *pl. 244*. 1828; Bryologist **7**: 14. 1904.

EXSICCATAE: Austin, Musci App. Suppl. *533*, Sull. Musci Cub. Wright. *83*.

The var. *Donnellii* is simply a xerophytic condition in which the leaves fall off and the terminal branches become brittle, thus propagating the species; in fact, the fruit is seldom found. Austin and J. D. Smith collected it at Caloosa, Florida, in 1876–78 and Mr. Severin Rapp has reported it from Sanford. In all our Jamaica collections I have found it but once, on a calabash tree.

28. PRIONODON DENSUS (Sw.) C. Müll. Bot. Zeit. **2**: 130. 1844

Hypnum densum Sw. Prod. 141. 1788.
Hypnum densum Hedw. Sp. Musc. 282. 1801.
Hypnum? densum Sw. Fl. Ind. Occ. **3**: 1829. 1806.
Neckera crassa Hornsch. Fl. Brasil. **1**: 56. 1840.
Pilotrichum densum C. Müll. Syn. **2**: 160. 1850.

HABITAT AND TYPE LOCALITY: "In Blue Mountains, southern Jamaica, on roots of trees."

DISTRIBUTION: Jamaica, Cuba, Haiti, Mexico, Costa Rica, and Panama, 1,500–2,000 ft.; also in South America.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 74* (from Swartz' type); Bot. Zeit. **2**: *pl. 1*.

EXSICCATAE: Pringle, Musci Mex. *10,483*.

29. PILOTRICHUM COMPOSITUM (Sw.) P. Beauv. Prod. 82. 1805

Hypnum compositum Sw. Prod. 141. 1788.
Neckera composita Hedw. Sp. Musc. 203. 1801.
Neckera composita Sw. Fl. Ind. Occ. **3**: 1792. 1806.

HABITAT AND TYPE LOCALITY: "On trunks of trees in woods, interior of Jamaica."

DISTRIBUTION: Jamaica and Grenada ("Costa Rica"?).

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 16. f. 8–13* (from Swartz' type).

30. LEPIDOPILUM POLYTRICHOIDES (Sw.) Brid. Bryol. Univ. **2**: 269. 1827

Hypnum polytrichoides Sw. Prod. 141. 1788.
Hypnum polytrichoides Hedw. Sp. Musc. 244. 1801.
Orthotrichum polytrichoides Brid. Musc. Recent. **2**^{2}: 31. 1801.
Neckera polytrichoides Sw. Fl. Ind. Occ. **3**: 1794. 1806.
Lepidopilum polytrichoides var. *costaricense* Ren. & Card. Bull. Soc. Roy. Bot. Belg. **32**^{1}: 192. 1893.
Hookeria Carionis C. Müll. Bull. Herb. Boiss. **5**: 205. 1897.

HABITAT AND TYPE LOCALITY: "On branches of trees and shrubs, also on rocks, mountains of Jamaica and Hispaniola."

DISTRIBUTION: Jamaica, Cuba, Haiti, Porto Rico, Guadeloupe, Martinique, Montserrat, and St. Vincent to South America: also, Mexico, Guatemala, Costa Rica, and Panama.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 61* (from Swartz' type); Schwaegr. Suppl. **3**: *pl. 231*.

EXSICCATAE: Husnot, Pl. Ant. Fr. *156*.

31. HELICODONTIUM CAPILLARE (Sw.) Jaeg. Adumb. **2**: 225. 1876–77

Hypnum capillare Sw. Prod. 141. 1788.
Leskea capillaris Hedw. Descr. **4**: 25. 1793.
Leskea capillaris Sw. Fl. Ind. Occ. **3**: 1813. 1806.

HABITAT AND TYPE LOCALITY: "On trunks of trees, interior of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, Porto Rico; also in Mexico and South America.

ILLUSTRATION: Hedw. Descr. **4**: *pl. 10*.

EXSICCATAE: Sull. Musci Cub. Wright. *70;* Pringle, Musci Mex. *759*.

32. RHACOPILUM TOMENTOSUM (Sw.) Brid. Bryol. Univ. **2**: 719. 1827

Hypnum tomentosum Sw. Prod. 141. 1788.
Hypnum tomentosum Hedw. Descr. **4**: 48. 1793.
Hypnum tomentosum Sw. Fl. Ind. Occ. **3**: 1823. 1806.
Rhacopilum tomentosum var. *gracile* Besch. Mém. Soc. Sci. Nat. Cherbourg. **16**: 257. 1872.

HABITAT AND TYPE LOCALITY: "On roots of trees near rivers, temperate regions of Hispaniola."

DISTRIBUTION: Louisiana, Bermuda, Cuba, Jamaica, Haiti, Santo Domingo, Guadeloupe, to Trinidad and South America; Mexico, Costa Rica, Guatemala, Nicaragua, and Panama; also in Asia and Africa.

ILLUSTRATIONS: Hedw. Descr. *pl. 19;* Bryologist **10**: *pl. 5*.

EXSICCATAE: Sull. Musci Cub. Wright. *74;* Pringle, Musci Mex. *10,501*.

33. CALLICOSTELLA DEPRESSA (Sw.) Jaeg. Adumb. **2**: 352. 1875–76

Hypnum depressum Sw. Prod. 141. 1788.
Leskea depressa Hedw. Sp. Musc. 215. 1801.
Leskea depressa Sw. Fl. Ind. Occ. **3**: 1804. 1806.

HABITAT AND TYPE LOCALITY: "On bark of trees, mountains of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Porto Rico, Haiti, and Guadeloupe.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 53. f. 1–7* (from Swartz' type).

34. **Clastobryum trichophyllum** (Sw.) E. G. Britton, comb. nov.

PLATE 25

Hypnum trichophyllum Sw. Prod. 141. 1788.
Hypnum trichophyllum Hedw. Sp. Musc. 274. 1801.
Neckera trichophylla Sw. Fl. Ind. Occ. **3**: 1798. 1806.
Lepyrodon trichophyllus Mitt. Jour. Linn. Soc. **12**: 422. 1869.
Leucodon trichophyllus Jaeg. Adumb. **2**: 122. 1877.
Lepyrodon trichophyllus robustior Besch. Ann. Sci. Nat. VI. **3**: 224. 1876.

Palamocladium trichophyllum C. Müll. Flora **82**: 465. 1896.
Palamocladium trichophyllum subtile C. Müll. Hedwigia **37**: 240. 1898.
Orthothecium trichophyllum Fleisch. Fl. Buit. 3: 667. 1906.

Plants light yellowish green, glossy; stems rooting and creeping, with simple erect branches, often 2 cm. high and prolonged into slender flagellate branchlets bearing brown septate gemmae in clusters in the axils of the upper leaves; branch-leaves crowded, spreading, glossy, strongly plicate when dry, lanceolate-acuminate, 3–5 mm. long, ecostate, margins plane, serrate; cells linear, walls porose, slightly thickened, alar cells shorter and broader, curved, forming a small, serrate auricle. Autoicous, perichaetial leaves shorter, paler, more suddenly subulate, more sharply serrate. Seta erect, straight or flexuose, red, 15–25 mm. long; calyptra cucullate; capsule erect, ovoid-cylindric, sometimes contracted below the mouth when dry, 2–3 mm. long, lid rostrate; annulus none; walls with irregular square or hexagonal cells 27–54 μ long $\times$ 27 μ wide; neck short, stomatose; peristome double; teeth incurved, brown, narrow, not perforate, papillose, with slightly trabeculate lamellae; endostome paler, also papillose with a short basal membrane and rudimentary or imperfect cilia, segments shorter than the teeth, not split along the keel; spores green, minutely papillose, unequal in size, 5 μ–16 μ, maturing in winter.

Forming bright glossy mats in shade on trunks and roots of tree-ferns and palms on high mountains, rarely on rocks. Fruit rare!

HABITAT AND TYPE LOCALITY: "On bark and trunks of old trees, Jamaica."

DISTRIBUTION: Jamaica, Cuba, Porto Rico, Haiti, Santo Domingo, St. Kitts, Dominica, Martinique. Guadeloupe, St. Vincent, Montserrat, and Trinidad to Venezuela.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 71;* E. & P. Nat. Pfl. 1^3: 773. *f. 580 J–L.*

EXSICCATAE: Husnot, Pl. Ant. Fr. *183*, as *Meteorium sericeum* Sch.

On account of the rarity of its fruit this species has been placed in a variety of genera none of which seem to me to be correct. Its double peristome and different habit remove it from *Lepyrodon* and its tropical distribution from *Orthothecium*, the species of which are alpine or arctic and subarctic. Its relationship however seems to me to be more with the *Entodontaceae*, where Fleischer has placed it; the presence of septate gemmae, and the ecostate leaves and more or less imperfect endostome, show its relationship to *Clastobryum indicum* Dozy & Molk. as figured by Brotherus (E. & P. Nat. Pfl. 1^3: 874. *f. 640.* 1907) but the leaf cells are porose and the walls are thickened as shown on the same page in *f. 639* of *C. planulum* Mitt.

Clastobryum americanum Cardot, originally described from Mexico, also occurs on the slopes and summit of Sir John Peak above Cinchona, in the Blue Mountains of Jamaica, and Mr. R. S. Williams has collected it in Bolivia at 8,000 ft. near Cargadera in 1902.

35. THUIDIUM MICROPHYLLUM (Sw.) Jaeg. Adumb. 2: 251. 1876–77

Hypnum microphyllum Sw. Prod. 142. 1788.
Hypnum microphyllum Hedw. Sp. Musc. 269. 1801.
Hypnum microphyllum Sw. Fl. Ind. Occ. 3: 1821. 1806.
Hypnum calyptratum Sull. Pac. R. R. Rep. 4: 190. 1856.

HABITAT AND TYPE LOCALITY: "On roots of trees, Jamaica."

DISTRIBUTION: Canada to Florida and the Bahamas, Jamaica, Cuba, and Mexico.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 69* (from Swartz' type); Sull. l. c. *pl. 100*.

EXSICCATAE: Sull. Musci Cub. Wright. *99*.

36. SEMATOPHYLLUM CAESPITOSUM (Sw.) Mitt. Jour. Linn. Soc. 12: 479. 1869

Hypnum caespitosum Sw. Prod. 142. 1788.
Leskea caespitosa Hedw. Sp. Musc. 233. 1801.
Leskea caespitosa Sw. Fl. Ind. Occ. 3: 1807. 1806.
Rhaphidostegium caespitosum Jaeg. Adumb. 2: 454. 1875–76.
*Hypnum loxense** Sull. Proc. Am. Acad. Arts & Sci. 5: 287. 1861. Not Hooker, 1822.

HABITAT AND TYPE LOCALITY: "On roots of trees, mountains of Hispaniola."

DISTRIBUTION: Cuba, Jamaica, Haiti, Porto Rico, Guadeloupe,

* The real *Sematophyllum loxense* (Hook.) Jaeg. has been found in Cuba.

and Martinique, to Trinidad and South America; also Mexico and Costa Rica.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 49.*

37. SEMATOPHYLLUM PUNGENS (Sw.) Mitt. Jour. Linn. Soc. **12**: 477. 1869

Hypnum pungens Sw. Prod. 142. 1788.
Hypnum pungens Hedw. Sp. Musc. 237. 1801.
Leskea pungens Sw. Fl. Ind. Occ. 3: 1806. 1806.
Pungentella pungens C. Müll. Hedwigia **37**: 260. 1898.

HABITAT AND TYPE LOCALITY: "Roots of trees in moist woods, mountains of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Porto Rico, Virgin Islands, Guadeloupe, Martinique, and Dominica to South America; also Mexico and Guatemala to Panama.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 60* (from Swartz' type).

EXSICCATAE: Sull. Musci Cub. Wright. *104;* Husnot, Pl. Ant. Fr. *186.*

38. PLEUROPUS CONGESTUS (Sw.) Broth. E. & P. Nat. Pfl. **1**^{3}: 1138. 1908

Hypnum congestum Sw. Prod. 142. 1788.
Hypnum congestum Hedw. Sp. Musc. 283. 1801.
Leskea congesta Sw. Fl. Ind. Occ. 3: 1809. 1806.
Homalothecium congestum Jaeg. Adumb. 2: 311. 1877–78.

HABITAT AND TYPE LOCALITY: "On old trunks of trees, interior of Jamaica."

DISTRIBUTION: Jamaica, Haiti, Montserrat, and Dutch Guiana.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 74. f. 4–7.* 1801.

Excepting for the illustration given by Hedwig, little is known of this species in modern times. Mitten and Brotherus had not seen specimens. At the British Museum there is a specimen labelled "*Leskea congesta* Sw. Ind. Occ. ex *Cl. Swartzio.* J. Vahl," which is evidently a mixture of *Palamocladium leskeoides* and *Clastobryum trichophyllum.* Hedwig's description calls for a plant with entire somewhat secund, falcate leaves and a horizontal capsule, characters which do not agree with either of the species named above.

The synonymy of *Palamocladium* is as follows:

Palamocladium leskeoides (Hook.) E. G. Britton, comb. nov.
Hookeria leskeoides Hook. Musc. Exot. *pl. 55*. 1818.
Leskea Bonplandi Hook.; Kunth. Syn. Pl. Aeq. **1**: 61. 1822.
Hypnum Bonplandi C. M. Syn. **2**: 463. 1851.
Homalothecium Bonplandi Jaeg. Adumb. **2**: 379. 1875-76.
Palamocladium Bonplandi Broth. Bot. Jahrb. **24**: 281. 1897.
Isothecium Bonplandi haitense Ren. & Card. MS. in herb.
Pleuropus leskeoides Hook. MS. in Herb.

39. ORTHOSTICHOPSIS TETRAGONA (Sw.) Broth. E. & P. Nat. Pfl. 1^3: 805. 1906

Hypnum tetragonum Sw. Prod. 142. 1788.
Hypnum? tetragonum Hedw. Sp. Musc. 246. 1801.
Hypnum? tetragonum Sw. Fl. Ind. Occ. **3**: 1833. 1806.
Pterigynandrum aureum Brid. Mant. 101. 1819.
Pterigynandrum quadrifarium Brid. Bryol. Univ. **2**: 194. 1827.
Isothecium tetragonum Brid. Bryol. Univ. **2**: 377. 1827.
Neckera quinquefaria C. Müll. Syn. **2**: 124. 1850.
Neckera tetragona C. Müll. Syn. **2**: 125. 1850.
Meteorium tetragonum Mitt. Jour. Linn. Soc. **12**: 431. 1869.
Pilotrichella tetragona Besch. Mém. Soc. Sci. Nat. Cherbourg **16**: 223. 1872.

HABITAT AND TYPE LOCALITY: "On trunks of trees, near summits of mountains in Jamaica."

DISTRIBUTION. Jamaica, Cuba, Santo Domingo, to Trinidad and Guiana; also in Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama.

ILLUSTRATION: Hedw. Sp. Musc. *pl. 63*. 1801 (from Swartz' type).

This moss is not uncommon in Jamaica and was known to Hans Sloane* and Dillenius,† who called it "the square-branched *Hypnum* from Jamaica." Both of these authors figured it rather poorly.

* Hist. Jam. **1**: 68. *pl. 25. f. 3*. 1707.
† Hist. Musc. 335. *pl. 43. f. 73*. 1741.

40. SCHLOTHEIMIA TORQUATA (Sw.) Brid. Bryol. Univ. 1: 323. 1826

Hypnum torquatum Sw. Prod. 142. 1788.
Hypnum torquatum Hedw. Sp. Musc. 246. 1801.
Neckera torta Sw. Fl. Ind. Occ. 3: 1800. 1806.
Schlotheimia torta Schwaegr. Suppl. 1^2: 39. 1816.
Schlotheimia pellucida C. Müll. Bull. Herb. Boiss. 5: 561. 1897.
Schlotheimia undato-rugosa C. Müll. Hedwigia 37: 238. 1898.

HABITAT AND TYPE LOCALITY: "On old mossy trunks of trees in woods, mountains of Jamaica."

DISTRIBUTION: Jamaica and Cuba, 5,000-6,000 ft. alt.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 63. f. 4-7* (from Swartz' type).

EXSICCATAE: Sull. Musci Cub. Wright. *52*.

41. MACROMITRIUM CIRRHOSUM (Sw.) Brid. Bryol. Univ. 1: 316. 1826

Hypnum cirrhosum Sw. Prod. 142. 1788.
Anoectangium cirrhosum Hedw. Sp. Musc. 42. 1801.
Neckera cirrhosa Sw. Fl. Ind. Occ. 3: 1802. 1806.
Schlotheimia cirrosa Schwaegr. Suppl. 3^1. 1827.

HABITAT AND TYPE LOCALITY: "On trunks of trees, temperate parts of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, Santo Domingo, Porto Rico, St. Kitts, Guadeloupe, Martinique, Montserrat, and Trinidad to South America; also, Guatemala and Panama.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 5;* Schwaegr. Suppl. *pl. 201A*.

EXSICCATAE: Sull. Musci Cub. Wright. *51;* Husnot, Pl. Ant. Fr. *144*.

42. THUIDIUM INVOLVENS (Hedw.) Mitt. Jour. Linn. Soc. 12: 575. 1869

Leskea involvens Hedw. Descr. 4: 27. 1794.
Leskea involvens Swartz, Fl. Ind. Occ. 3: 1815. 1806.

HABITAT AND TYPE LOCALITY: "With *Helicodontium capillare* on trunks of trees, interior of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, Porto Rico, Guadeloupe, and Barbados to South America; also Mexico (Yucatan).

ILLUSTRATION: Hedw. Descr. *pl. 11* (from Swartz' type).

EXSICCATAE: Sull. Musci Cub. Wright. *98*.

43. **Turckheimia linearis** (Sw.) E. G. Britton, comb. nov.

Tortula linearis Sw. Fl. Ind. Occ. **3**: 1765. 1806.
Barbula linearis Brid. Mant. Musc. 88. 1819.
Trichostomum lineare Broth. E. & P. Nat. Pfl. 1^3: 394. 1902.

HABITAT AND TYPE LOCALITY: "On dry calcareous rocks, Hispaniola."

DISTRIBUTION: Jamaica, Cuba, and Haiti.

Our specimens from Jamaica and Cuba have a well-developed, slender peristome, which disappears from the old capsules. I believe this species to be congeneric with *Turckheimia guatemalensis* Broth., which also shows traces of a peristome though the capsules are all old. The section of the leaf in *T. linearis* is remarkable for having two rows of guide-cells of about 10 cells each in the costa, with a stereid band both above and below. The costa is rather broader than in *T. guatemalensis* and smooth on the dorsal side, showing as a prominent white rib to the leaf. It is papillose on the upper surface and the cells of the blade bear several minute papillae on both surfaces. This peculiarity of the costa removes *Turckheimia linearis* from *Trichostomum;* and although there is but a single row of guide-cells in *T. guatemalensis*, their macroscopic resemblance is so close that they appear to be congeneric.

44. ISOPTERYGIUM TENERUM (Sw.) Mitt. Jour. Linn. Soc. **12**: 499. 1869

Hypnum tenerum Sw. Fl. Ind. Occ. **3**: 1817. 1806.

HABITAT AND TYPE LOCALITY: "On trunks of trees, mountains of Jamaica."

DISTRIBUTION: Jamaica, Cuba, Haiti, Guadeloupe, Martinique, St. Lucia, to Trinidad and South America; also Bermuda, and Louisiana to Florida.

EXSICCATAE: Sull. Musci Cub. Wright. *107*.

According to Dr. Andrews' notes "the Swartz specimens, which are deposited in the collections of the Naturhistoriska Riksmuseum at Stockholm, are distributed through the herbarium of non-Scandinavian mosses, which are, in general, arranged after Paris's Index. Packets are generally uniform, one to many on the herbarium sheet. Swartz' specimens are recognizable by labels in his handwriting included in the packet, by the kind of paper with water-mark to which he pasted them and references of others to the origin of specimens."

We have seen specimens of all but two of these species, and have duplicates of many of them; it is therefore our intention to distribute sets of these and other West Indian mosses, in exchange for other exsiccatae and duplicates from the West Indies, Central America, and South America.

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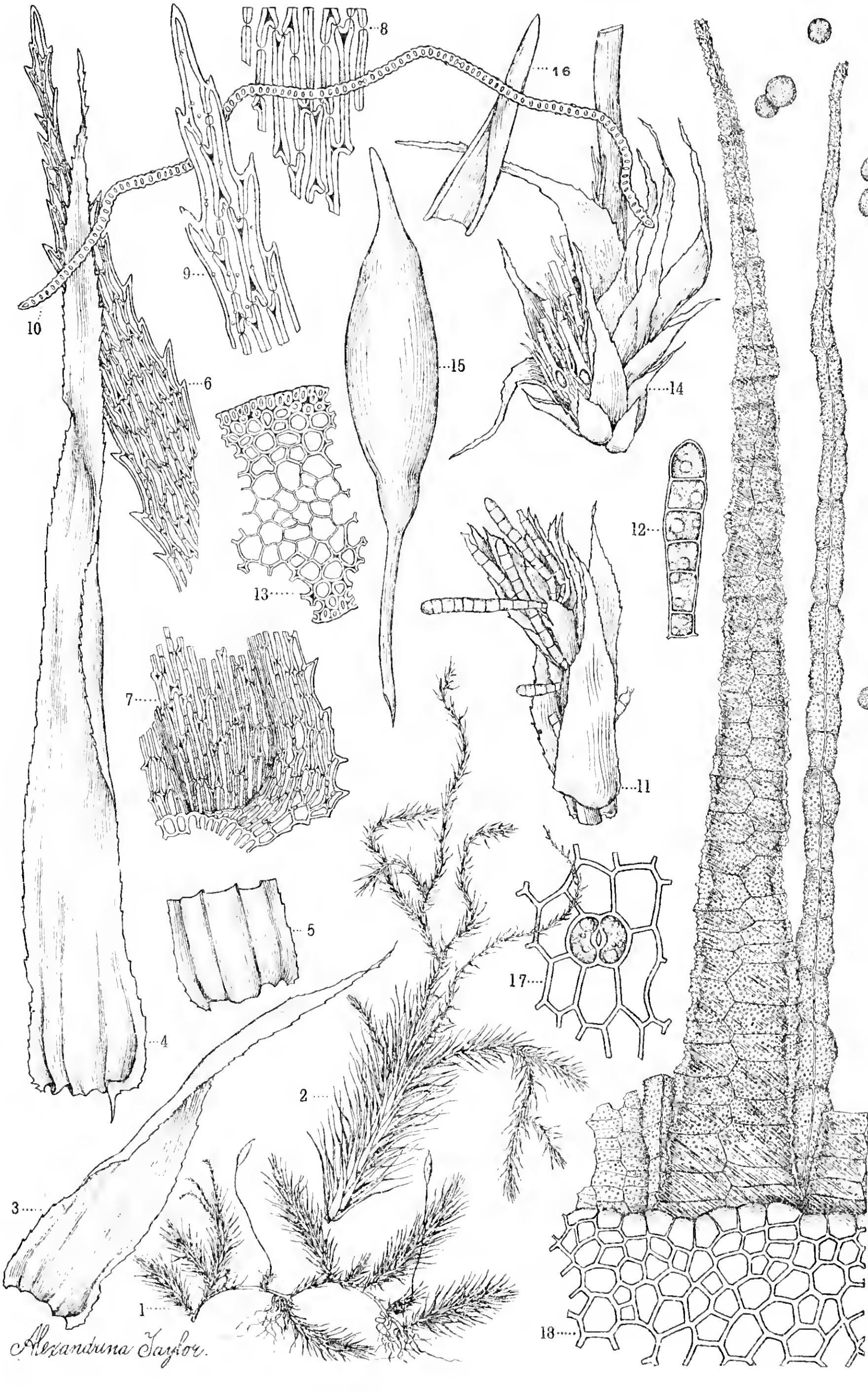
Explanation of plate 25

Clastobryum trichophyllum (Sw.) E. G. Britton

The figures were drawn from magnifications three times as great as expressed in the numbers, which represent the magnifications of the figures as they stand in the reproduction.

1. Plant, natural size.
2. Portion of branch showing the flagellate branches and gemmae, × $2\frac{2}{3}$.
3. Outline of stem leaf, × $16\frac{2}{3}$.
4, 5. Outlines of branch leaves, × $16\frac{2}{3}$.
6. Apex of leaf, × 108.
7. Basal portion of leaf, showing the auricle, × 108.
8. Median cells, × 263.
9. Apex of leaf showing the pores in the walls of the apical cells, × 263.
10. Cross section of leaf, × 140.
11. Branch with gemmae, × 85.
12. Gemma, × 138.
13. Cross section of stem, × 140.
14. Perichaetial bud, leaves of one side removed to show the paraphyses and archegonia, × 12.
15. Capsule, × 10.
16. Calyptra, × 10.
17. Stoma from base of capsule, × 195.
18. Portion of peristome and upper part of capsule, × 195.
19. Spores, × 195.



CLASTOBRYUM TRICHOPHYLLUM (Sw.) E. G. Britton

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 162

PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION
I. ALPINE REGION

By P. A. RYDBERG

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Phytogeographical notes on the Rocky Mountain region
I. Alpine region

P. A. RYDBERG

The alpine region, roughly speaking, is the region between the perpetual snow and the timber line.

THE UPPER LIMIT, THE PERPETUAL SNOW LINE

A perpetual snow line cannot be spoken of in the southern Rockies. Even the highest peaks do not have a perpetual snow cap like Mt. Shasta or Mt. Hood. This is probably due to the less amount of moisture and precipitation. It is true that many of the peaks have perpetual snow on them, but this snow is mostly in the form of snow-drifts and small glaciers, especially on the northern or northeastern side. The amount of snow depends to a great extent on local conditions, as for instance on an exposure to the northwestern winds or partial protection from the direct action of the summer sun. The Snowy Range of Colorado has more snow than the much higher Gray's Peak, Sierra Blanca, or Mount Massive. In the Canadian Rockies and especially in the Selkirk Mountains the conditions are different and more like those of the European Alps. There the highest peaks have a perpetual snowcap and the glaciers extend far down in the valleys. In northern Montana, as for instance in the Sperry Glacier region, are found the only places in the United States where in the Rockies there are glaciers of any great extent, notwithstanding the fact that the Montana mountains are considerably lower than those of Colorado.

THE LOWER LIMIT, THE TIMBER LINE

The timber line is by no means a well-defined boundary line. It is in reality a broad zone in which the woody vegetation gradually thins out from the dense forest to the last krumholz. In nature there is not found any sharp line between two regions, but only a gradual transition zone between them.

Different authors have fixed the timber line differently, as for instance:

1. At the forest line; i. e., where the continuous forest stops.

2. At the grove line; i. e., where the trees cease to form communities of larger or smaller size.

3. At the tree line; i. e., where the arboreal species cease to form trees.

4. The absolute timber line; i. e., where these species disappear altogether, even as krumholz.

To me it seems superfluous to consider more than two of these "lines," viz. the "forest line" and the "absolute timber line," which may be called the Lower and the Upper Timber Lines. But to fix the limit between the alpine region and the subalpine region at either of the two would be erroneous in certain respects. The region between these two timber lines is a transition zone between the two, or it may be still better called a zone of strife. A continuous warfare goes on between the forest and the alpine grassland. A seed from the forest succeeds in germinating between the low alpine plants. A tree grows up. The alpine plants are smothered in the shade. More tree seeds have a chance to germinate and a grove is formed and the forest region is carried upwards.

On the other hand, snow and wind kill the trees on the edge of the forest or the grove, the shade is gone and the alpine plants soon take possession. But more on this subject below.

The width of this transition zone or zone of strife depends on many factors. In one place the forest meets a steep cliff and stops abruptly. In such places there is no transition zone. In other places the lower timber line has been pushed down by a ledge of snow thick enough to last the larger part of the summer and having the power of smothering the trees, but not the herbaceous alpine vegetation. Still above the lower timber line at these places, there might be found isolated trees or groves of trees a thousand feet higher up, especially on higher ground, where the snow has not been so deep. In other places the lower timber line might have been pushed down by wind, not so much by its mechanical force as by its desiccating effects.

In treating the alpine region, I would be inclined to place the boundary at the lower timber line, i. e., the forest line, so as to include all open spaces of the transition zone as these have a flora alpine in character. In treating the subalpine region, however, I would place the boundary at the absolute timber line, so as to include the groves, isolated trees, and krumholz as well. The groves, if of any size, contain not only the trees themselves, but also wood plants and underbrush belonging to the subalpine region. They are either encroaching on the region above or are themselves remnants of a former forest. So are also the isolated trees and krumholz, although not associated with other plants of the forest.

In a mountain region extending through twenty degrees of latitude, from lat. 35° to lat. 55° (the Rockies north of 55° have not been considered in my work), the altitude of the timber line necessarily varies greatly. In Colorado the lower timber line is found at an altitude of between 3,200 and 3,400 m. and the upper at 3,400 to 3,500 or rarely 3,600 m. In Montana the lower one is at 2,200–2,500 m. and the upper 2,500–2,700 m. In the Canadian Rockies they are even lower.

FACTORS GOVERNING THE TIMBER LINE

The conditions that have been given as causing or modifying the timber line are:

1. A decreased temperature during the growing season.
2. Too short a growing season.
3. Late frost on account of lack of protection from snow.
4. Strong desiccating winds.
5. Deep snow.
6. Form of precipitation.
7. Large mountain masses.
8. Exposure to and protection from direct sunlight.
9. Physiographical barriers.
10. Ecological barriers.
11. Economic timber line.

LOW TEMPERATURE

It is natural that too low a temperature should be one of the important factors causing the disappearance of the forest. The temperature during the winter has, however, very little influence upon the growing of trees. It is shown that the temperature in temperate regions in the winter often is much lower than in many places in the arctic. It is doubtful if the temperature in the alpine region of Colorado ever becomes as low as on the plains of Montana, where some years ago it was recorded as 65° F. below zero. The only place within the alpine region of the Rockies where a record has been kept during the winter is on the top of Pikes Peak, and here only for a few years. No such low temperature has been recorded there. It is during the growing season that a low temperature limit for forest growths can be spoken of, for during the winter, when the life functions of the plants lie dormant, a few degrees more or less makes in reality no difference. Köppen claims that no trees can grow at a place where the mean temperature during the warmest months of the year does not reach 10° C. Schroeter gives a table taken from the records of the meteorological central station at Zürich in which are given the mean temperatures in July at fifteen stations at the timber line in Switzerland. The mean temperature ranges from 7.75° C. at Zermatt to 15.4° at Monte Generoso. This shows that the timber line may reach a little higher than the isotherm 10° C. and in other cases not reach it. Schroeter is particular enough to mention that at Monte Generoso the low timber line is not an artificial one made by man. See below. The arctic timber line seems to be more coincident with the isotherm 10° C. for July than the timber line in the mountains.

SHORT GROWING SEASON

Another cause of the timber line is the shortness of the growing season. This, it may be, is just as important a factor as the preceding. When speaking of the arctic timber line, it is easy to see that this factor acts parallel to the preceding, for near the sea-level places of the same isotherm in the summer have about the same length of summer, but not so in the mountain regions. In the heads of valleys, where big snowdrifts are formed during the winter and melt late in the summer, and along glaciers and permanent snow the frost is kept longer in the ground and the growing season is naturally shortened. Therefore, in many places in the Rockies, the timber line is a thousand feet or more lower in the valley heads than on the slopes on the sides. The shortness of the season may have also another effect on the timber line, i. e., the seeds would not have time to ripen. This may be of great importance in accounting for the arctic timber line, but it can have very little influence on the alpine timber line, for most of the conifers that reach the timber line have winged seeds, which are easily carried above the line of maturing seed and then can germinate there.

Late frost

Another factor which has been given as having effect on the timber line is late frost in the spring, killing the new sprouts. As the conifers, which are most affected, do not readily produce a second crop of shoots the same season, the forests after a few repeated frosts will soon be killed. In such a way large districts of pine forest were destroyed in Montana a few years ago.

Strong desiccating winds

One of the most important factors is strong wind. This factor has been much underestimated in earlier times, but later writers on the phytogeography of the arctic regions have recognized it more and more. In my belief it is one of the most important factors in the Rockies. The trees at the timber line and especially those few isolated stragglers above the real forest line show marked effects from the wind. The trees are not only low, stunted, gnarled, ragged, with enormously elongated lower branches often spreading on the ground, but conspicuously one-sided, telling at the glance the direction of the prevailing winds. But the mechanical influence of the wind is not the most important, however. Of greatest importance are its desiccating effects, especially in the winter. This effect of the wind has been recognized even in arctic regions, but it must be taken into consideration still more in the mountains. The timber line is much lower on the north side of the Alps than on the south side. This is due not only to the difference in temperature (for the difference in altitude should not be so great), but still more to the desiccating northern winds. In some places in Montana these winds are northerly, but in southeastern Colorado and southern Utah they are from the southwest, and it is on this side of the mountains that the timber line is the lowest. In the Abajo Mountains of southeastern Utah, for instance, there is no timber line at all on the southern and western sides, for no timber is growing between the semi-arid cedar-pinyon belt and the top of the mountains. The whole southern and western slopes of the mountains proper are covered by a semi-arid grass formation. The highest peaks (altitude about 11,000 feet) just reach the timber line on the eastern and northern sides, only one or two hundred feet belonging to the alpine region. The desiccating effects of the winds are increased by the thinness of the atmosphere.

DEEP SNOW

Deep snow is also a factor. As the desiccating wind lowers the altitude on the wind-swept ridges so does the snow in the heads of the valleys. I have already mentioned that the great snow-drifts or glaciers here shorten the growing season. But the snow-drifts have also a direct mechanical influence on the timber line in the way of smothering the tree vegetation. Herbs and low shrubs can withstand being covered by snow much better than a tree, for their growing season does not begin before the snow is practically off the ground, while the tops of the trees may be above the snow and exposed to the summer heat months before the snow cover of their roots and lower branches has melted. The lower portion of the tree is cut off from the air while the upper portion is already in vital activity. It is easy to distinguish trees stunted by the action of the wind from those stunted by the smothering snow. In the former the lower branches are enormously developed compared with the upper, and often creeping along the ground, while in the latter the lower branches are dead and covered by fungi or their mycelia.

The usual condition in the Rockies is, that wherever there is a large valley head, where the snow has a chance to lodge, this is always devoid of trees, except in places of higher ground, where the snow-drift has not been so deep and has had time to melt earlier in the summer. On such higher places there are often groves or isolated trees. The absence of trees in such a valley head is due less to the shortness of the season, produced by the snow, than to the smothering of the tree vegetation.

FORM OF PRECIPITATION

Another important factor influencing the timber line is the form of precipitation. In high altitudes the air is too rare to hold much moisture and the rain falls at the least lowering of the temperature. The rain falls therefore either in the form of mists or in light showers, which only wet the surface of the ground. It may be sufficient to keep alive the low rosettes or cushions of the alpine vegetation, but it is not sufficient for the deep-rooted trees. Furthermore, if a little heavier rain should come, the water would rush down the steep slopes of the mountains, not having time to sink down into the ground. The tops of the mountains are therefore arid, because the air is too rare to hold much moisture and quickly gives it up in light showers. Nowhere in the Rockies proper is the moisture very great. In the foot-hill regions and on the surrounding plains the temperature is too high in the summer to allow any precipitation. These zones are therefore also arid. It is at middle elevations that the precipitation is the greatest. The air here is dense enough to hold more moisture and the temperature low enough to allow precipitation. It is also at middle altitudes that we find the forest areas in the Rocky Mountain region.

LARGE MOUNTAIN MASSES

In the Swiss Alps, observations have been made that in regions of large mountain masses, as for instance in the Monte Rosa region and the Engadine and others, the timber line is higher than on isolated mountains. I have not seen any satisfactory explanation of this fact. It may be due partly to the fact that the central mountains of such massed groups are more or less protected from the desiccating winds. It may be due also to the circumstances that in the winter more snow lodges between the mountains, the melting of it is more retarded, and the water is more arrested in its downward course by the trees and their roots. The air in the summer time would be therefore, from the evaporation, more loaded with moisture, which would naturally also benefit the mountain tops. Whatever the real cause may be, it seems as if the observations made in Switzerland hold good in the Rockies. From my own experience, I know that the timber line in the isolated Belt Mountains and Crazy Mountains in Montana is much lower than in the main Rockies, as for instance in the Yellowstone Park. The Belt Mountains would not be high enough to have a timber line if they were in the Rockies. So also in the Wahsatch and La Sal Mountains, the timber line is much lower than in the Rockies of Colorado. Even in the Colorado Rockies themselves, the timber line seems to be higher in places where the mountains are more massed. So for instance is it higher on Mount Massive and other mountains around Leadville than on the more isolated Pikes Peak, Sierra Blanca, or Longs Peak. I understand that on the isolated Mount Shasta, the timber line is much lower down than on the peaks of the Sierra Nevada, but here it may depend upon the proximity of the ocean, the greater moisture, and the consequently larger snowcap on Mount Shasta.

EXPOSURE TO SUNLIGHT

Exposure to the direct sunlight and protection from it evidently also have influence on the altitude of the timber line, though perhaps not so much as one might expect. The insolation on the mountain tops in direct sunlight is very great. Schroeter estimates that on the top of Mont Blanc it is 26 per cent stronger than in Paris. The Rockies of Colorado have about the same height as Mont Blanc and are situated from 5° to 8° farther south, and the insolation is fully as great. The amount of light and heat which can be absorbed by the plant is therefore much greater on the mountain tops than on the plains. The radiation is also very great in the higher altitudes so that the temperature in the shadow is much lower. According to Schroeter the timber line lies 100–200 meters higher on the southern side than on the northern, and DeCandolle claims that the limiting line of vegetation, of plants in general, is at an average of 200–300 meters higher on the equatorial side. These statements cannot be verified in the Rockies. The timber line in Colorado is, perhaps, higher on the northern side, but this is probably due to other conditions. The timber line trees of Colorado are mainly *Picea Engelmannii*, *Abies subalpina*, and *Pinus aristata*. The first two are trees that need a great deal of moisture, and their seedlings require shade. These two trees are therefore more confined to the more shady and wetter northern slopes, where they also extend higher up. *Pinus aristata* is a tree that stands much more drought and is found more on the southern slopes, but it is a tree of little value as a forest tree, growing scatteringly only. To me it appears to be a species which has passed its best development and is in process of dying out.

PHYSIOGRAPHICAL BARRIERS

One of the conditions modifying the altitude of the timber line is to be found in physiographical barriers. Among these may be counted snowdrifts and glaciers, but these have been already mentioned. Besides these, the most important are precipitous cliffs and rock-slides. Very little needs to be said about these barriers. Neither gives the forest trees a chance to grow. Meeting one of these barriers, the timber may cease to grow thousands of feet below the physiological timber line. Wherever a steep cliff arrests the forest, many of the alpine plants will be found growing in the crevices, hundreds or even a thousand feet lower than usual, and there are a few plants characteristic of the rock-slides. These may be best included in the alpine vegetation.

ECOLOGICAL TIMBER LINE

Sometimes an ecological timber line is mentioned, i. e., where bacteria in the soil and other organisms necessary for the growth of trees cease to exist. Theoretically, I can easily see that such a timber line may exist, but practically I have no information that such a one is found in the Rocky Mountains, distinct from the merely physiological one. No investigation in this line has been made.

ECONOMIC TIMBER LINE

In Switzerland there exists also an economic timber line. The alpine meadows are there used as summer pastures for sheep and goats. These animals make depredations on the young trees and hinder the spreading of the forest, but in many places the subalpine forest is actually cut down by men to make room for more pastures. In either case the alpine conditions will be brought further down the mountains and the timber line lowered. Such an economic timber line cannot be said to exist in the Rockies.

ALPINE VEGETATION

After having discussed the causes of the timber line, it is easier to define what an alpine plant is. In short, it is a plant that can endure the climate of the mountains above the timber line. It is a plant that requires less heat during the growing season than the forest trees, or that can survive a shorter growing season, or is less affected by frost, and besides can better withstand desiccating winds, deep snow, reduced precipitation, etc., or a combination of such conditions. Some authors claim that alpine and arctic plants are xerophytes, but they are not necessarily so. While most of the plants of alpine and arctic regions can withstand a great deal of drought, in fact are xerophytic plants, it is not the case with all. Not a few of the arctic-alpine plants require a great deal of moisture, growing only below and around snowbanks, or in springy or boggy ground, as for instance several species of *Ranunculus*, *Saxifraga* (in extended sense), *Salix*, and many grasses and sedges. There are in the arctic-alpine regions even true aquatics, as for instance among the phanerogams, *Catabrosa aquatica*, *Phippsia algida*, *Sparganium minimum*, and *S. hyperboreum*, and a few species of *Potamogeton*.

NEW YORK BOTANICAL GARDEN

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 163

NEW FERNS FROM TROPICAL AMERICA—III

By MARGARET SLOSSON

NEW YORK
1913

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[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 40: 687-690. 6 J 1914.]

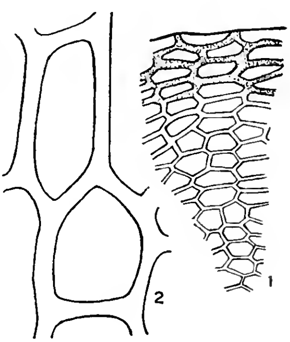
New ferns from tropical America—III

MARGARET SLOSSON

(WITH PLATE 26)

Trichomanes rhipidophyllum Slosson, sp. nov.

Rhizome creeping, about 5 mm. in diameter, thickly tomentose; stipes brown and tomentose to within about 1 mm. of the lamina, then green, slightly hairy, and winged by the narrowly and abruptly decurrent base of the lamina, in fertile fronds 5–7 mm. long, in sterile 1.5–3 mm. long; laminae shining bright green, delicately papyraceous, the fertile 0.8–1.1 cm. long, 0.7–1.3 cm. broad, suborbicular, almost semicircular, or subtrapezoid, at apex slightly once cleft, at base subtruncate or cuneate, the sterile 0.4–1.3 cm. long, 0.5–1.5 cm. broad, round-reniform to ovate or broadly obovate; margins irregularly undulate or sublobate, marginal hairs few, slender, simple or binate; surfaces or at least the lower one with a few short club-shaped mostly 2-celled hairs on the veins; veins few, distant, in the sterile fronds subflabellately forked, midveins of fertile fronds flexuose, with about 3 pairs of branches forked 1–4 times, spurious veins short, almost none; cells of the lamina between the veins variable, mostly narrow, 0.056–0.116 mm. long, 0.020–0.040 mm. broad, their walls 0.004–0.008 mm. broad; involucres 1–2, borne at the base of the central cleft of the lamina, almost wholly exserted, the lips 1.5 mm. broad, their brown border 1–4 cells deep; spores globose, 0.044–0.056 mm. in diameter.



Trichomanes rhipidophyllum. 1, cellular structure of the margin of the lip of the involucre, enlarged; 2, cells from between the veins of a sterile frond, very much enlarged.

Type in the Underwood Herbarium at the New York Botanical Garden, collected on a tree in a damp forest near Onaca, Colombia, at an altitude of 760 m., Aug. 24, 1898–99, *Herbert H. Smith 2445*. A note on the label says "not observed elsewhere." A very distinct species belonging to the section or subgenus *Didymoglossum* not likely to be mistaken for any other. Marked by its bright shining green color, rounded, undulate or not more than sublobate margins, and few flabellately forked veins tapering toward the apex. From *Trichomanes sphenoides* Kunze, which also has flabellately forked veins tapering toward the apex, it may be easily distinguished by the greater distance between the tips of the true veins, varying from .5 to 2 or 2.5 mm., and by the very thick walls of the cells of the laminae.

Polystichum machaerophyllum Slosson sp. nov.

Rhizome erect, its scales light brown, 2.5–6 mm. long, ovate to oblong, fimbriate or subfimbriate; scales of lower part of the stipes similar, passing into minute scales scattered over both surfaces of the frond, which are elongate-caudate, entire or slightly toothed, from a short more or less fimbriate-ciliate base; fronds up to 51 cm. long, up to 7.1 cm. broad; stipes 2.5–20.5 cm. long, brownish-stramineous or greenish, channeled on the face, rounded at the back, the upper part channeled also or flattened on the sides; rachis similar to upper part of the stipe; laminae brownish olive, lanceolate or lance-linear, slightly tapering toward base, pinnate, the apex in young fronds often deltoid-acuminate, in mature fronds of two kinds, the first subcaudate, elongate-linear or lanceolate, subentire or undulate or serrate-lobate, often proliferous at tip, the second flagelliform and proliferous at tip, naked or with a few small scattered pinnae, both kinds sometimes on the same frond, the second terminating the first; pinnae mostly alternate, 8–27 to a side, usually approximate or distant, the lower short-stalked, the upper sessile or subsessile or adnate, often passing into short variously shaped often obovate segments, principal pinnae broadly cuneate-hastate, above the auricles deltoid to linear, the basal margins entire, the outer margin subentire or undulate or with one or more minute occasionally spinescent teeth or in large fronds irregularly crenately lobed, the lobes sometimes mucronate, basal auricles and apex of pinnae spinescent; texture coriaceous-chartaceous; venation pinnate, obscure, veins very oblique, about 1–4 times forked, the basal auricles with distinct midveins; sori usually about midway between the midvein and the margin of the frond, or nearer the midvein, rarely a few submarginal; indusia more or less erose or with a few cilia; sporangia glabrous; spores cristate.

Type in the Underwood Herbarium at the New York Botanical Garden, collected at Arroyo del Medio, above the falls, Sierra

Nipe, Oriente, Cuba, altitude 450–550 meters, December 22, 1909, *J. A. Shafer 3262*. The label reads: "Shaded rocks near water."

This plant is closely related to both *Polystichum ilicifolium* Fée and *P. triangulum* (L.) Fée, and very likely may be a hybrid between the two. Numerous specimens have been seen, all Cuban, and excepting Wright's specimens, all from the Province of Oriente. Wright's specimens bear the indefinite inscription of "Cuba" and "Cuba orientale," but are dated 1859, 1860, and 1865. During the first two years Wright is known to have collected in the Province of Oriente, but in 1865 he is believed to have collected only in the western part of Cuba.*

Polystichum machaerophyllum in a mature state is easily distinguished from *P. triangulum* by the peculiar apices of the fronds, varying from long-drawn-out to flagelliform, non-proliferous to proliferous. It is more likely to be confused with *P. ilicifolium*, but may be known by the proportionately broader and shorter laminae; their darker olive-green color, resembling that of *P. triangulum;* and the larger and longer pinnae, distinctly biauriculate at base, with the part above the basal auricles not short and margined with large sharp oblique spinescent teeth, as in *P. ilicifolium*, but more or less extended and subentire or very slightly toothed or crenately lobed, the lobes entire or minutely mucronate. The indusia are peculiar, varying from only slightly erose to markedly so with a few cilia. The indusia in *P. triangulum* are entire, and in *P. ilicifolium* vary from markedly erose to conspicuously long-ciliate. *P. decoratum* Maxon, the only other Cuban *Polystichum* known with fronds flagelliform at apex, may be readily recognized by its pinnae widely excised, not auricled, at base on the lower side.

The following specimens of *P. machaerophyllum* at the New York Botanical Garden and in the U. S. National Herbarium in Washington have been examined:

CUBA: Camp La Gloria, south of Sierra Moa, Oriente, Dec. 24–30, 1910, *Shafer 8096;* bank of river among stones, Camp La Barga, Oriente, altitude 450 meters, February 22–26, 1910, *Shafer 4127;* on moist rocks, Cooper's Ranch, base of El Yunque Mountain, Baracoa, March, 1903, *Underwood & Earle 1179, 1180;*

* See L. M. Underwood, A Summary of Charles Wright's Explorations in Cuba Bull. Torrey Club 32: 298, 300. 1905.

vicinity of Baracoa, February 1–7, 1902, *Pollard, Palmer & Palmer 237;* "in Cuba Orientale," 1859, 1860, *C. Wright 828* in part; without specific locality, 1865, *C. Wright 828* in part.*

Explanation of plate 26

1–3. *Trichomanes rhipidophyllum;* 1, rootstocks and leaves, slightly reduced; 2, 3, sterile and fertile frond, enlarged, showing venation; *H. H. Smith 2445.*

4, 5, and unnumbered figures. *Polystichum machaerophyllum;* 4, indusia, enlarged, *Shafer 3262;* 5, scale from stipe, enlarged, *Wright 828;* unnumbered figures, various forms of the plant, reduced, *Shafer 3262.* (Some of the basal auricles of the pinnae do not show clearly in the photograph, owing to a slight infolding of the dried specimens.)

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* In the Underwood Herbarium and in the U. S. National Herbarium the remainder of Wright's no. 828 is *P. decoratum.*

1–3. TRICHOMANES RHIPIDOPHYLLUM Slosson
4–5, and unnumbered figures. POLYSTICHUM MACHAEROPHYLLUM Slosson

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 164

STUDIES OF WEST INDIAN PLANTS—V

NATHANIEL LORD BRITTON

NEW YORK
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Studies of West Indian plants—V

NATHANIEL LORD BRITTON

23. ADDITIONAL SEDGES FROM JAMAICA*

CYPERUS COMOSUS Poir. in Lam. Encycl. 5: 185. 1817

Shettlewood, Hanover (*Harris 11647*).

DISTRIBUTION: Cuba; continental tropical America.

SCIRPUS CUBENSIS Kunth, Enum. 2: 172. 1837

River Head, near Ewarton (*Underwood 1860*).

DISTRIBUTION: Southern United States; Cuba; Hispaniola; Trinidad; continental tropical America; tropical Africa.

RYNCHOSPORA CYMOSA (Michx.) Ell. Bot. S. C. and Ga. 1: 58. 1816

Savannah, Upper Clarendon (*Harris 11103*).

DISTRIBUTION: Southeastern United States; Cuba; Hispaniola; Porto Rico; Martinique; South America.

Rynchospora jamaicensis sp. nov.

Rootstocks short; culms clustered, slender, 6–8 dm. long, reclining. Leaves 2–3 mm. wide, rather stiff, the lower 2–5 cm. long, the middle ones 12–15 cm. long, those subtending the clusters of spikelets 6–10 cm. long; sheaths of all the leaves densely short-pubescent; spikelets loosely panicled in several distant axillary clusters and in a terminal one, short-pedicelled, the axis of the inflorescence loosely pubescent; spikelets narrowly conic, 4–5 mm.

* See Bull. Dept. Agric. Jam. 5: Suppl. 1. 1907. Bull. Torrey Club 35: 568, 569. 1909.

long, maturing 2 achenes; lower empty scales broadly ovate, the others lanceolate, acuminate; bristles none; achenes obovate-orbicular, 1 mm. long, pale brown, shining, finely cancellate; tubercle triangular-lanceolate, acuminate, flat, about one-third longer than the achene, its base nearly truncate.

Rocky banks in the Blue Mountains of Jamaica; *type*, from Hardware Gap, *N. L. Britton 3322*, collected Sept. 9, 1908. Related to *R. elongata* (Boeckl.) Clarke, and to *R. polyphylla* Vahl, but at once distinguished from them by its pubescent sheaths.

24. THE GENUS PITHECOLOBIUM IN CUBA

A. Pods curved or coiled, dehiscent, the valves twisting after separating.

- 1. Seeds with a fleshy aril; stipules spinescent; pinnae 1 or 2 pairs; leaflets 2–4 pairs.
  - Leaflets 1–6 cm. long (species perhaps confluent).
    - Leaflets spinulose-mucronate. — 1. *P. circinale.*
    - Leaflets obtuse or mucronulate.
      - Leaflets chartaceous; petioles of the lower leaves, at least, longer than the petiolules. — 2. *P. Unguis-cati.*
      - Leaflets coriaceous; petioles shorter than the petiolules or as long.
        - Petioles and petiolules stout; leaflets large, 2.5–6 cm. long. — 3. *P. guadalupense.*
        - Petioles and petiolules slender; leaflets small, 1–3 cm. long. — 4. *P. bahamense.*
  - Leaflets only 3–7 mm. long. — 5. *P. Hystrix.*
- 2. Seeds without a fleshy aril; stipules not spinescent; pinnae 2 pairs or more; leaflets 3 pairs or more.
  - 1. Leaflets obovate to oval, large, 1.5–6 cm. long, 3–6 pairs to each pinna.
    - Calyx subtruncate at base; seeds oblong, about twice as long as wide. — 6. *P. savannarum.*
    - Calyx narrowed at base; seeds suborbicular to obovate.
      - Pinnae 3 or 4 pairs; leaflets 4–6 pairs; calyx narrowly campanulate, thin. — 7. *P. discolor.*
      - Pinnae 1 or 2 pairs; leaflets 2–4 pairs; calyx broadly campanulate, coriaceous.
        - Calyx truncate, its teeth minute, mucronulate. — 8. *P. truncatum.*
        - Calyx teeth large, broadly ovate.
          - Calyx short-campanulate; stamen-tube short; leaflets broadly obovate. — 9. *P. obovale.*
          - Calyx long-campanulate; stamen-tube 5–6 mm. long; leaflets oblong to obovate. — 10. *P. pinetorum.*

2. Leaflets linear to oblong, small, 5–16 mm. long, 6–many pairs to each pinnule.
    Leaflets 2–3 mm. long, oblong, coriaceous. — 11. *P. nipense.*
    Leaflets 5–16 mm. long, thin, dull.
        Leaflets obliquely oblong, narrowed at base. — 12. *P. asplenifolium.*
        Leaflets linear, linear-lanceolate or oblong, obtuse, rounded or subcordate at the base.
            Leaflets oblong, 5–7 mm. long. — 13. *P. trinitense.*
            Leaflets linear.
                Pinnae 2 pairs; leaflets acute, strongly veined; pod compressed. — 14. *P. guantanamense.*
                Pinnae 3–11 pairs; leaflets obtuse, not strongly veined; pod swollen. — 15. *P. arboreum.*

B. **Pods straight, or curved, indehiscent, or dehiscent, the valves not twisting.**
    Unarmed trees.
        Pod straight or a little curved, compressed, turgid, fleshy; leaflets oblong to obovate, large. — 16. *P. Saman.*
        Pod straight, thin, very flat, chartaceous; leaflets linear, small, very numerous. — 17. *P. Berterianum.*
    Trees or shrubs, armed with spinescent stipules (*P. tortum* sometimes unarmed).
        Pod coriaceous, tardily dehiscent; stamens 2 cm. long or less, the tube short; leaflets many; spines straight. — 18. *P. tortum.*
        Pod chartaceous, thin and flat, dehiscent; stamens 5–6 cm. long, the tube much exserted; leaflets few; spines curved. — 19. *P. prehensile.*

1. PITHECOLOBIUM CIRCINALE (L.) Benth. Lond. Journ. Bot. 3: 201. 1844

Mimosa circinalis L. Sp. Pl. 517. 1753.

Thickets in dry districts at low elevations, southern Oriente; Hispaniola.

Bentham's record of this species for the Bahamas appears to refer to *P. mucronatum* Britton, which has quite different leaves. The Oriente plant differs from the typical one of Hispaniola in having smaller, thicker leaflets, less cuneate at the base, and is either glabrous or densely pubescent.

2. PITHECOLOBIUM UNGUIS-CATI (L.) Mart. Hort. Monac. 188. 1829

Mimosa Unguis-cati L. Sp. Pl. 517. 1753.

Cayo Sabinal, Camagüey (*Shafer* 1063); recorded by Richard as in various parts of the island, but is apparently rare. West Indies (except Bermuda); northern South America.

3. PITHECOLOBIUM GUADALUPENSE Chapm. Fl. S. U. S. 116. 1860

Cays of Camagüey; Bahamas; Florida Keys.

4. PITHECOLOBIUM BAHAMENSE Northrop, Mem. Torrey Club 12: 38. 1909

Cays of Camagüey; Bahamas.

5. PITHECOLOBIUM HYSTRIX (A. Rich.) Benth. in Hook. Icon. Pl. *pl. 1168.* 1876

Inga Hystrix A. Rich. Ess. Fl. Cub. 1: 471. 1845.

Pithecolobium calliandrifolium C. Wright; Griseb. Cat. Pl. Cub. 83. 1866.

Coastal thickets and hillsides: Camagüey, Santa Clara, Havana, Pinar del Rio; Bahamas.

6. **Pithecolobium savannarum** sp. nov.

A tree up to 7 m. high, with smooth bark, the foliage finely and densely puberulent when young, glabrous or sparingly puberulent when old. Leaves 1.5–2 dm. long, the rather stout petioles 1–2.5 cm. long, the glands somewhat elevated; pinnae about 4 pairs, the petiolules slender, 2 cm. long or less; leaflets 4–6 pairs, obliquely obovate, 1.5–3 cm. long, chartaceous, loosely reticulate-veined, deep green and somewhat shining above, pale and dull beneath, obtuse or retuse at the apex, acute at the base; peduncles axillary, slender, striate, glabrous, 7–9 cm. long; flowers short-racemose, white; pedicels slender, glabrous, 3–6 mm. long; calyx 3–4 mm. long, subtruncate at the base, campanulate, its teeth acute, ovate, often somewhat unequal; corolla funnelform, appressed-pubescent, 8 mm. long, its lobes ovate-oblong; stamens 15 mm. long, united about one-third their length; ovary and young pod densely pubescent; old pods 8–10 cm. long, the valves doubly coiled after dehiscence, moniliform, 4–6 mm. wide across the seed cavities, 2 mm. wide between them; seed cavities oblong, 8–10 mm. long.

Along a water course on barren savannas southeast of Holguin, Oriente, April 7, 1909 (*Shafer 1194*).

7. **Pithecolobium discolor** sp. nov.

A shrub 3 m. high, or a small tree up to 7 m. high, the young twigs and leaves densely puberulent, the old leaves glabrous or somewhat puberulent, 1–2 dm. long, the stout petioles 2 cm. long or less, the glands on the rachis between the pinnae orbicular, small. Pinnae 3 or 4 pairs; leaflets 4–6 pairs, obovate, chartaceous, 1.5–2.5 cm. long, dark green above, pale beneath, loosely reticulate-veined, obtuse or retuse at the apex, obliquely narrowed at the base; peduncles axillary, puberulent above, 5–11 cm. long; flowers short-racemose; pedicels puberulent, 4–6 mm. long; calyx narrowly campanulate, 4–5 mm. long, narrowed to the base, puberulent, its teeth ovate, 1 mm. long; corolla 7–8 mm. long, campanulate-funnelform, pubescent, its lobes oblong-ovate, ciliate; stamens 1.5–2 cm. long, the filaments united about one-fourth their length; pod coiled, 6–8 cm. long, 8–10 mm. wide, more or less constricted between the seeds; seeds blue and white, shining, orbicular, 4 mm. broad, the funicle slender.

Provinces of Havana, Pinar del Rio and Camagüey. Type from Batabano, April 10, 1903 (*Shafer 161*); apparently the same species at Old Kerr's Point, Abaco, Bahamas (*Brace 2017*).

8. **Pithecolobium truncatum** sp. nov.

A tree up to 12 m. high, the bark rough, the young twigs and leaves brownish-puberulent, the old foliage glabrous. Leaves 15 cm. long or less; petiole stout, 1–2 cm. long; glands oblong-orbicular; pinnae 1 or 2 pairs; leaflets 3 or 4 pairs (on leaves of shoots 1 or 2 pairs), obovate, coriaceous, 1.5–4 cm. long (those of shoots larger and suborbicular), obtuse at the apex, narrowed at the base, pinnately veined; peduncles axillary, 4–9 cm. long; flowers short-racemose; pedicels stout, puberulent, about 2 mm. long; calyx broadly campanulate, puberulent, coriaceous, 3 mm. long, the limb truncate, the teeth minute, mucronate; corolla finely pubescent, its tube 5–6 mm. long, its lobes 3 mm. long, lanceolate, acute; stamens about 2.5 cm. long, the filaments united about one-fourth their length; pod curved to a nearly complete circle, 6 or 7 cm. long, 8–10 mm. wide, scarcely or not at all constricted between the seeds; seeds blue and white, somewhat compressed, obovate, shining, 4 or 5 mm. long.

Southern Oriente. Type from gravelly hills, El Cobre, west of Santiago, March 23, 1912 (*Britton, Cowell & Shafer 12874*).

9. PITHECOLOBIUM OBOVALE (A. Rich.) C. Wright; Sauvalle, Anales Acad. Habana 5: 407. 1868

Inga obovalis A. Rich. Ess. Fl. Cub. 1: 472. 1845.

Calliandra revoluta Griseb. Cat. Pl. Cub. 83. 1866.

Leaflets mostly broadly obovate; stamen tube very short; pod flat, curved in a partly complete circle.

Hillsides and river banks. Pinar del Rio and Isle of Pines.

10. **Pithecolobium pinetorum** sp. nov.

A tree up to 10 m. high, the young twigs and leaves puberulent, the old foliage nearly or quite glabrous. Leaves 2 dm. long or less; petioles stout, 1.5–3 cm. long; glands oblong, somewhat elevated; pinnae 1 or 2 pairs; leaflets 3 or 4 pairs, coriaceous, oblong or obovate-oblong, pinnately and loosely reticulate-veined, rounded at the apex, narrowed or obtuse at the base, 3–6 cm. long; peduncles axillary, 3–6 cm. long; calyx coriaceous, campanulate, 5 mm. long, its teeth broadly obovate, rounded, somewhat unequal; corolla pubescent, its tube about 6 mm. long, its lobes 3 mm. long, ovate-lanceolate, acute; stamens 2–2.5 cm. long, united about one-fourth their length; pod curved into a nearly complete circle, about 7 cm. long, 12 mm. wide, flat, not constricted between the seeds; seeds blue and white, shining, orbicular-obovate, 5–6 mm. long.

Mountain pinelands of northern Oriente. Type from southeast of Paso Estancia, May 1–2, 1909 (*Shafer 1725*); fruit and seeds described from *Shafer 3096*, collected in pinelands of Sierra Nipe.

11. **Pithecolobium nipense** sp. nov.

A shrub or a tree up to 10 m. high, the young twigs, petioles and rachises permanently short-pubescent. Leaves 4–6 cm. long; petioles 6 mm. long or less; glands circular, elevated; pinnae 3 or 4 pairs; leaflets 10–16 pairs, oblong, coriaceous, approximate, 2–3 mm. long, 1.5 mm. wide, slightly inequilateral, obtuse at the apex, rounded or subtruncate at base, glabrous, dark green and lustrous above, pale and dull green beneath with the midvein prominent, glabrous or with a few scattered hairs; flowers unknown; pod curved into a partly complete circle, 6–10 cm. long, 7–8 mm. wide, compressed, glabrous, short-stipitate, not constricted between the seeds, or occasionally constricted; seeds blue, shining, oblong-obovate to obovate-orbicular, 6 mm. long.

Mountains of northern Oriente. Type from near Woodfred, Sierra Nipe, 450–550 m. altitude, Dec. 20, 1909 (*Shafer 3220*).

12. PITHECOLOBIUM ASPLENIFOLIUM Griseb. Cat. Pl. Cub. 83. 1866

Western Cuba. Known only from the type collection of *C. Wright 2403*.

13. **Pithecolobium trinitense** sp. nov.

A tree up to 10 m. high; young twigs, petioles and rachises densely brown-puberulent. Leaves 10–15 cm. long; glands circular, 1 mm. in diameter; petioles 1.5 cm. long or less; pinnae 6–8 pairs, approximate; leaflets 12–16 pairs on each pinna, oblong, chartaceous, slightly inequilateral, 5–7 mm. long, 3 mm. wide or less, rounded at the apex, obliquely obtuse at the base, glabrous or nearly so and dark green above, pale, and pubescent beneath, at least on the veins, the midvein prominent; peduncles densely puberulent when young, glabrous when old; young flower-heads densely puberulent; flowers unknown, apparently capitate; pod curved into a nearly complete circle, about 6 cm. long and 7 mm. wide, somewhat constricted between the seeds; seeds blue, shining, orbicular-obovoid, somewhat compressed, 5 mm. long.

Hillside, El Porvenir to Aguacate, Trinidad Mountains, Santa Clara, at 700–900 m. altitude, March 10, 1910 (*Britton & Wilson 5346, type*).

14. **Pithecolobium** (?) **guantanamense** sp. nov.

A tree, 10 m. high with flexuous twigs, the foliage sparingly villous-pubescent. Leaves 6–8 cm. long, petioles slender, 1 cm. long or less; glands scutellate, 0.5 mm. in diameter; pinnae 2 pairs; leaflets 20 pairs or fewer, linear, chartaceous, 5–7 mm. long, 1–1.5 mm. wide, inequilateral, pale green but somewhat darker above than beneath, acute at the apex, obliquely obtuse at the base, the few veins prominent beneath; flowers unknown; pod compressed, glabrous, chartaceous, dehiscent, doubly coiled, 6–8 cm. long, 7–8 mm. broad over the seeds, constricted between them, the coils about 2 cm. broad; immature seeds suborbicular, somewhat flattened, 4 mm. in greatest diameter.

Bank of a water course, United States Naval Station, Guantanamo Bay, Oriente, March, 1909 (*Britton 2051*).

15. PITHECOLOBIUM ARBOREUM (L.) Urban, Symb. Ant. **2**: 259. 1900

Mimosa arborea L. Sp. Pl. 519. 1753.
Pithecolobium filicifolium Benth. in Hook. Lond. Journ. Bot. **3**: 205. 1844.
? *Mimosa filicifolia* Lam. Encycl. **1**: 13. 1783.

Hillsides, river-banks and woodlands at lower and middle elevations, ascending, in Oriente, to at least 330 m.; all provinces and Isle of Pines; Hispaniola; Porto Rico; Jamaica; Mexico and Central America.

16. PITHECOLOBIUM SAMAN (Jacq.) Benth. Lond. Journ. Bot. **3**: 216. 1844

Mimosa Saman Jacq. Fragm. 15. 1809.

Calliandra Saman Griseb. Fl. Br. W. I. 225. 1860.

Hillsides and pastures; all provinces and Isle of Pines: widely distributed in the West Indies. Native of continental tropical America. Not a true *Pithecolobium*. Perhaps referable to *Zygia* [P. Br.] J. St. Hil. Exp. Fam. Nat. **2**: 246. 1805. The type of *Zygia*, which has long priority of publication over *Pithecolobium*, is *Z. arborescens* J. St. Hil., which is the same as *Pithecolobium latifolium* (L.) Benth.

17. PITHECOLOBIUM BERTERIANUM (Balbis) Benth. Lond. Journ. Bot. **3**: 220. 1844

Acacia Berteriana Balbis; DC. Prodr. **2**: 470. 1825.

Hillsides and woodlands in dry districts. Oriente, Camagüey, Santa Clara; Hispaniola; Jamaica.

Not a true *Pithecolobium*.

18. PITHECOLOBIUM TORTUM Mart. Herb. Fl. Bras. 114. 1837

Pithecolobium vincentis Benth. Lond. Journ. Bot. **3**: 222. 1844.

Acacia lentiscifolia A. Rich. Ess. Fl. Cub. 469. 1845.

Sand dunes, sandy river-banks, coastal thickets and hillsides near the coast, Santa Clara, Havana, Pinar del Rio, Isle of Pines; St. Vincent; Martinique; Central and South America.

Not a true *Pithecolobium*.

19. PITHECOLOBIUM PREHENSILE (C. Wright) Benth. Trans. Linn. Soc. **30**: 593. 1875

Calliandra prehensilis C. Wright; Sauvalle, Anales Acad. Habana **5**: 406. 1868.

Rocky river-banks, coastal thickets and saline plains, Oriente; Santa Clara. Endemic.

Perhaps a congener of *P. brevifolium* Benth., the type of the genus *Havardia* Small.

25. FURTHER NOTES ON COMOCLADIA*

1. COMOCLADIA PINNATIFOLIA L. Syst. ed. 10, 861. 1759

Professor Urban has pointed out to me that Linnaeus, who printed the specific name *pinnatif.*, more likely intended this contraction to mean *pinnatifolia* than *pinnatifida*, as I printed it, following the Kew Index.

12. COMOCLADIA PLATYPHYLLA A. Rich.

The species ranges westward in Cuba into the province of Pinar del Rio as far as Corrientes Bay (*Britton & Cowell 9914*).

14. **Comocladia cuneata** nom. nov.

Comocladia acuminata Britton, Bull. Torrey Club 37: 349. 1910. Not *C. acuminata* Moc. & Sessé; DC. Prodr. 2: 65. 1825.

Known hitherto only from the type specimen, this species has recently been collected by Rose, Fitch and Russell (*4185*) at San Pedro de Macoris, Santo Domingo. The broadly cuneate leaf-bases distinguish it from its relatives.

15. COMOCLADIA GLABRA Spreng.

In Flora Portoricensis, Professor Urban refers to this species, the *C. acuminata* Moc. & Sessé, as a variety, and states that it is Porto Rican, rather than Mexican as supposed by DeCandolle.

18. COMOCLADIA DODONAEA (L.) Urban, Symb. Ant. 4: 360. 15 My 1910; Britton, Bull. Torrey Club 37: 351. 29 Jl 1910

The species extends eastward in the Virgin Islands to Tortola (*Britton & Shafer 902*).

26. ANOTHER WEST INDIAN DENDROPANAX

Dendropanax filipes sp. nov.

A slender, straggling shrub up to 3 m. high. Leaves oblong-oblanceolate, thin-coriaceous, 12 cm. long or less, 1–3 cm. wide, rather strongly pinnately veined, acutish at the apex, obtuse or acute at the base, the petioles 2–25 mm. long; peduncle very slender, bracted at the base, apparently nodding, 10 cm. long or

* See Bull. Torrey Club 37: 345–363. 1910.

less; umbel about 12-flowered; pedicels filiform, 8–15 mm. long; flowering calyx only 1.5 mm. high and broad, broadly obconic; petals 1.5–2 mm. long, oblong-lanceolate.

Peckham woods, Upper Clarendon, Jamaica, at about 800 meters elevation, May 22, 1912, *Harris 11057*.

Among the species discussed by me in 1912,* this most nearly resembles the Cuban *D. cuneifolium*.

27. THREE UNDESCRIBED BOURRERIAS†

Bourreria mucronata sp. nov.

A divaricately branched shrub 2 m. high, with very slender branches, the young twigs and branches of the inflorescence appressed-pubescent. Leaves elliptic, 1–3 cm. long, 8–15 mm. wide, coriaceous, acute and mucronate at the apex, narrowed at the base, revolute-margined, reticulate-veined, strongly tuberculate-roughened, shining, and when young hispid above, dull and smooth beneath, the midvein impressed above, prominent beneath, the lateral veins about 5 on each side, the petioles 2–3 mm. long, pubescent when young; inflorescence 3–6-flowered; calyx, in bud, oblong, 3 mm. long, glabrous; corolla unknown; fruiting calyx 3 mm. long, its lobes acutish or obtuse; drupe ovoid-spherical, pointed, 5 mm. long.

Limestone cliff, San Diego de los Baños, Pinar del Rio, Cuba, (*Britton, Earle & Gager 6791*), Sept. 1910. Probably nearest related to *B. setoso-hispida* O. E. Schulz.

Bourreria moaensis sp. nov.

A slender shrub or tree up to 3.3 m. high, glabrous throughout. Leaves obovate or broadly oblanceolate, 10 cm. long or less, 2.5–4.5 cm. wide, coriaceous, revolute-margined, acute or acutish, at the apex, narrowed at the base, the midvein impressed above, prominent beneath, the lateral veins about 6 on each side of the midvein, the petiole stout, only 2–4 mm. long; flowers unknown; fruiting inflorescence stalked, 4 cm. broad or less, 6–8 cm. long, its branches stout; fruiting calyx about 13 mm. long, its ovate acute lobes about as long as the tube; fruit subglobose, 12 mm. in diameter.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8182*), Dec. 24–30, 1910.

* Bull. Torrey Club **39**: 1–14.

† See O. E. Schulz in Urban, Symb. Ant. **7**: 45–71; 349.

Apparently nearest related to *B. grandiflora* (Poir.) Griseb., which has smaller, obtuse leaves with much narrower petioles.

Bourreria Nashii sp. nov.

A shrub, about 1 m. high, the young twigs pilose. Leaves obovate to oblong-obovate, 18 mm. long or less, 4–7 mm. wide, coriaceous, revolute-margined, densely rough-papillose and inconspicuously veined above, canescent, reticulate-veined and the midrib prominent beneath, obtuse, retuse or apiculate at the apex, narrowed at the base, the margin papillose-hispid, the pubescent petiole about 1 mm. long; fruits solitary or 2 together, orange-brown, terminal, subsessile, depressed-globose, about 6 mm. in diameter, persistent calyx-lobes ovate-lanceolate, acute, loosely pubescent.

Foothills, between Marmelade and San Michel, Haiti, Aug. 4, 1905 (*Nash & Taylor 1380*).

Nearest related to the Cuban *B. pauciflora* O. E. Schulz.

28. NOTES ON PSYCHOTRIA*

PSYCHOTRIA LIGUSTRIFOLIA (Northr.) Millsp. Field Col. Mus. **2**: 172. 1906

To the range of this species may now be added BERMUDA, where it is locally abundant, and hitherto referred to *P. undata* Jacq.; FLORIDA: Key Largo (*Curtiss 5501*); CUBA; on coral-rock, Madruga (*Britton & Shafer 776*).

PSYCHOTRIA SULZNERI Small, Fl. Miami 176. 26 Ap 1913
Psychotria pulverulenta Urban, Symb. Ant. **7**: 456. 15 Au 1913.

29. NOTES ON VARIOUS SPECIES

JUNIPERUS LUCAYANA Britton, N. A. Trees 121. 1908
Juniperus australis Pilger, in Urban, Symb. Ant. **7**: 479. 1913.

The types of both are from the Bahamas.

THRINAX MICROCARPA Sargent, Gard. & For. **9**: 162. 1896

Western part of Cayo Cruz, Camagüey, Cuba (*Shafer 2800*). Not heretofore recorded from Cuba:—South Florida; Bahamas.

* See Urban, Symb. Ant. **7**: 433–477.

MAYTENUS PHYLLANTHOIDES Benth. Bot. Sulph. 54. 1844

Cayo Coco, Cayo Sabinal and Cayo Romano, Camagüey, Cuba (*Shafer 1062, 2507, 2633, 2678*). Not heretofore recorded from Cuba:—Southern Florida; Mexico and Lower California.

CROTON NUMMULARIAEFOLIUS A. Rich. in Sagra, Hist. Cub. **11**: 211. 1850

Rocky coastal thicket, Guanica, Porto Rico (*Britton & Shafer 1911*). New to Porto Rico; Cuba.

ACALYPHA ALOPECUROIDEA Jacq. Obs. **3**: 196. 1789

Palo Seco, Porto Rico (*Brother Hioram*, Oct. 1912). New to Porto Rico:—Bahamas, Cuba, Hispaniola, Jamaica, Grenada.

CALLICARPA HITCHCOCKII Millsp. Field Col. Mus. Bot. **2**: 312. 1909

Alto del Aji, Cayo Romano, Camagüey (*Shafer 2791*). Not previously recorded from Cuba:—Bahamas.

CLERODENDRON (?) CALCICOLA Britton, Bull. Torrey Club **39**: 9. 1912

The habitat of this plant, omitted at the place of publication, is limestone rocks, Corrientes Bay, Cuba (*Britton & Cowell 9871*).

LYCIUM CAROLINIANUM Walt. Fl. Car. 84. 1788

Rio Gavelan, Santa Clara (*Britton, Earle & Wilson 6027*) and on Cayo Romano, Camagüey, Cuba (*Shafer 2632*). Not heretofore recorded from Cuba:—Southeastern United States.

STENOSTOMUM MYRTIFOLIUM Griseb. Fl. Br. W. I. 334. 1860

Western part of Cayo Cruz, Camagüey, Cuba (*Shafer 2798*). Not previously reported from Cuba:—Bahamas.

ERNODEA LITTORALIS Sw. Prodr. 29. 1788

In my discussion, in 1908, of the species and races of the genus *Ernodea* Sw. (Bull. Torrey Club **35**: 203–208) I remarked that no species had been found in Cuba, but I can now record the typical race of *E. littoralis* Sw. as occurring between Punta Sol and

Molinas, Nipe Bay, Oriente (*Shafer 1794*), and also on Cayo Romano, Camagüey (*Shafer 2621*).

SPERMACOCE KEYENSE Small, Flora Florida Keys 141. 11 Au 1913

Spermacoce floridana Urban, Symb. Ant. 7: 550. 15 Au 1913.

From the printed dates of publication, Dr. Small has four days priority.

ACANTHOSPERMUM HISPIDUM DC. Prodr. 5: 522. 1836

Island of Culebrita, Porto Rico (*Britton & Wheeler 280*).

30. ASTER IN THE WEST INDIES

Scapose, the scapes monocephalous; leaves rosulate, linear-oblong, pilose.	1. *A. Grisebachii.*
Caulescent, branched, polycephalous.	
Rays large, surpassing the involucre.	
Leaves, except the basal ones, reduced to small imbricated scales; rootstocks tuberous.	2. *A. adnatus.*
Leaves normal, the upper often small, but distant.	
Involucre-bracts densely pubescent, acuminate; inflorescence wand-like; rootstocks tuberous.	3. *A. lucayanus.*
Involucre-bracts glabrous or nearly so, or puberulent; inflorescence paniculate; rootstocks not tuberous.	
Not fleshy, or but slightly so, at least the lower leaves flat, linear to spatulate.	
Involucre-bracts acuminate, glabrous.	4. *A. bahamensis.*
Involucre-bracts obtuse or merely acutish.	
Very densely leafy; involucre-bracts puberulent; rays white.	5. *A. Burgessii.*
Not densely leafy; involucre-bracts glabrous.	6. *A. dumosus.*
Fleshy; leaves all narrowly linear, thick, subterete.	7. *A. Bracei.*
Rays small, little if at all surpassing the involucre.	
Stem-leaves lanceolate, 6–12 cm. long, 2 cm. wide or less.	8. *A. inconspicuus.*
Stem-leaves linear to linear-oblong.	
Stem-leaves elongated-linear; involucre-bracts acuminate.	9. *A. exilis.*
Stem-leaves oblong-linear; involucre-bracts acute.	10. *A. squamatus.*

1. **Aster Grisebachii** Britton, nom. nov.

Haplopappus marginatus Griseb. Cat. Pl. Cub. 149. 1866. Not *Aster marginatus* H.B.K.

Sandy and gravelly pine-lands, Pinar del Rio and Isle of Pines, Cuba.

A species with solitary heads on long, sparingly bracted scapes, the rootstocks much-branched, the rosulate linear-oblong leaves pilose, the rays bright white.

2. ASTER ADNATUS Nutt. Jour. Acad. Nat. Sci. Phila. 7: 82. 1834

Pine-lands, Great Bahama Island; southeastern United States.

3. ASTER LUCAYANUS Britton, Bull. N. Y. Bot. Gard. 4: 143. 1906

Pine-lands, Great Bahama Island.

4. **Aster bahamensis** Britton, sp. nov.

Stout, fibrous-rooted, slightly fleshy, glabrous, 3–20 dm. high. Lower leaves and those of sterile shoots with sheathing petioles 4–7 cm. long, the blades oblong to linear-oblong or oblong-lanceolate, obtuse or acute, 4–8 cm. long, 5–20 mm. wide, sparingly crenate-dentate or entire, narrowed into the petiole, the midvein prominent, the lateral veins obscure; upper stem-leaves linear, entire, 6 cm. long or less, those of the branches nearly subulate, 3–12 mm. long; heads numerous, paniculate; involucre nearly cylindric, 6–8 mm. high, its bracts linear, acuminate, about 0.7 mm. wide, green with scarious margins, or the inner merely green-tipped; rays purple, 4–5 mm. long; achenes columnar, 2.5 mm. long, the angles roughened; pappus brownish, twice as long as the achene.

Moist grounds and marshes, Great Bahama, Andros, Eleuthera and Cat Island. Type from Barnett's Point, Great Bahama (*Britton & Millspaugh 2621*).

5. **Aster Burgessii** Britton, sp. nov.

Rootstock short, thick. Stems clustered or solitary, densely leafy, often with many short branches, pubescent, at least above, 5 dm. high, or less. Lower and basal leaves oblanceolate or spatulate, obtuse or acutish, distantly low-serrate, 2–5 cm. long, 6 mm. wide or less, narrowed into slender, ciliate, partly clasping petioles, otherwise glabrous; stem-leaves similar, but narrower and sessile or nearly so, those of the branches 4–10 mm. long; heads numerous, thyrsoid-corymbose; involucre about 5 mm. high, its bracts in about 4 series, linear, ciliolate or glabrous, obtuse or acutish; rays white, 5–8 mm. long.

Rocky river-banks, Pinar del Rio, Cuba. Type collected on Rio Portales, near Guane, March, 1911 (*Britton, Britton & Cowell 9751*). Erroneously recorded by Grisebach as *Aster carneus* Nees.

6. ASTER DUMOSUS L. Sp. Pl. 873. 1753

Pinelands, high mountains of Santo Domingo; eastern United States.

7. ASTER BRACEI Britton; Small, Fl. Miami 190. 1913

Brackish marshes and savannas, southern Florida, Bahamas, Cuba.

8. ASTER INCONSPICUUS Less. Linnaea **5**: 143. 1830

Erigeron expansus Poepp.; Spreng. Syst. **3**: 518. 1826. Not *Aster expansus* Nees.

Marshes, ditches and roadsides at lower and middle elevations: Cuba; Jamaica; South Florida; Mexico.

9. ASTER EXILIS Ell. Bot. S. C. & Ga. **2**: 344. 1824

Wet grounds, provinces of Santa Clara, Havana and Pinar del Rio, Cuba; Andros Island, Bahamas; southeastern and southern United States.

10. ASTER SQUAMATUS (Spreng.) Hieron. Bot. Jahrb. **29**: 19. 1901

Conyza squamata Spreng. Syst. **3**: 515. 1826.

Naturalized along roadsides, especially on Ireland Island and Boaz Island, Bermuda. The plant erroneously listed by Lefroy as *Aster Trifolium* L., was probably this species, misprinted for *A. tripolium* L. Native of southern South America.

31. UNDESCRIBED SPECIES OF JAMAICA

Lasiocroton Harrisii sp. nov.

A tree, about 8 m. high, the stout twigs densely brown-tomentose when young, bearing prominent leaf-scars. Leaves oblong-elliptic, rather firm in texture, 8–15 cm. long, 7 cm. wide or less, sharply acuminate at the apex, narrowed at the base, sparingly pubescent above, densely pubescent beneath, yellowish-green, somewhat paler beneath than above, pinnately veined, with about 5 veins on each side of the midvein, the margin entire or slightly undulate, the stout, tomentose petioles 10–16 mm. long; fruiting racemes slender, tomentose, equalling the leaves or longer, the slender tomentose pedicels 10–15 mm. long; fruiting calyx tomentose, 4 mm. broad, the sepals ovate, acute; capsule obtusely 3-lobed, 7 mm. broad, 3–4 mm. high, densely brown-tomentose; styles 2 mm. long; stigmas fimbriate; seeds subglobose, 2.5 mm. in diameter.

Peckham woods, Upper Clarendon, Jamaica, September 9, 1912 (*Harris 11192*).

L. Fawcettii Urban, of Dolphin Head Mountain, Jamaica, differs in having nearly glabrous long-petioled leaves.

Varronia clarendonensis sp. nov.

A slender shrub with weak straggling branches, the twigs loosely pilose. Leaves broadly ovate-elliptic, 5–10 cm. long, 3–7 cm. wide, firm-chartaceous in texture, rather strongly pinnately veined, coarsely and sharply dentate, obtuse at the apex, obtuse or subtruncate at the base, loosely pilose beneath, scabrous-pubescent and papillose above, the loosely villous petioles 1.5 cm. long or less; peduncles slender, pilose, 5–8 cm. long; heads globose, densely many-flowered, 2 cm. in diameter; calyx brown-pilose above, its tube about 4 mm. long, its lobes triangular-ovate with linear, pilose, curled tips 5–6 mm. long; corolla about 9 mm. long, its lobes short and broad; stamens about equalling the corolla; filaments filiform; anthers oblong.

Peckham woods, Upper Clarendon, Jamaica, July 7, 1911 (*Harris 10995*).

Jacobinia (?) **jamaicensis** sp. nov.

Stem stout, 3–6 dm. high, densely long-villous. Leaves lanceolate to ovate-lanceolate, 6–10 cm. long, 1.5–3 cm. wide, rather firm in texture, densely villous-pubescent on both sides, acuminate at the apex, narrowed to an obtuse base, with villous petioles 2–4 mm. long; spike terminal, few-flowered; bracts lanceolate, acuminate, villous, about 1.5 cm. long; calyx-teeth narrowly lanceolate, loosely villous; corolla rose-colored, 3.5 cm. long, loosely villous, 2-lipped, the teeth of the lobes short and rounded; filaments slender, nearly as long as the corolla, glabrous; anthers 2.5 mm. long.

Crevices of limestone rocks, Peckham woods, Upper Clarendon, Jamaica (*Harris 10978, type; 11178*).

32. UNDESCRIBED CUBAN SPECIES

Copernicia rigida Britton & Wilson, sp. nov.

A tree up to 6 m. high, with a slender cylindric trunk. Leaf-blades wedge-shape, 13–15 dm. long, deeply grooved below the middle, bright green above, paler beneath and sometimes armed on the margins of the grooves with small, straight or recurved teeth 1–4 mm. long; leaf margins armed mostly below the middle with numerous recurved, straight, ascending, or sometimes hooked teeth 3–7 mm. long; petiole short, stout, 1–1.5 dm. long, 1–1.4 dm. broad, unarmed; ligule rigid, rhombic-ovate, 2.5–3.5 dm. long, 1.7–2 dm. broad, armed on the margin with ascending, recurved, straight or sometimes hooked teeth 3–12 mm. long, coalescent with and decurrent on the short petiole; inflorescence lax, branches slender, the ultimate ones densely clothed with short hairs; spathes of the inflorescence abruptly tapering to a long, slender acuminate tip; flowers unknown; fruit subglobose, 1.5–1.6 mm. long, 1.4–1.6 mm. broad, brown, shining; old calyx persistent beneath the fruit, the lobes triangular; seed subglobose, 9–11 mm. long.

Type collected in the vicinity of Tiffin, Camagüey, Cuba, November 1–5, 1909 (*Shafer 2895*); also collected at Santa Lucea, Camagüey (*Shafer 971*); Province of Santa Clara (*Britton & Wilson 4563; Britton, Cowell & Earle 10299*).

Copernicia Cowellii Britton & Wilson, sp. nov.

A small tree, up to 3 m. high, the head globose, about 1 m. in diameter, very dense, the trunk up to 1.7 dm. thick, strictly cylindric. Leaves many, the blades shining, yellow-green above, covered with a bright white waxy bloom beneath, about 6 dm. long, somewhat wider than long, the younger erect, the older persistent, reflexed; petioles white-waxy, 1 dm. long or less, 3–5 cm. wide, flattened, armed with irregular, curved and somewhat hooked teeth 5–8 mm. long; margins of the leaves with many recurved teeth 2–3 mm. long, the leaf otherwise unarmed; inflorescence lax, the branches slender, densely clothed with short hairs; spathes of the inflorescence gradually tapering to long acuminate tips; calyx cylindric, 3–3.5 mm. high, the lobes strongly mucronate; corolla 5–6 mm. long, densely clothed with short, mostly appressed hairs on the outer surface, the lobes prominently grooved within below the middle, the grooves hairy on the margin, longitudinally converging and bearded above; dilated portion of the filaments prominently triangular; carpels truncate at the summit, grooved; styles nearly cylindric; fruiting panicles about twice as long as the leaves, pendent, glabrous, much-branched, slender, the stalk about as long as the fruit-bearing part; sheath closely appressed, the lower up to 1 dm. long; fruits close together on the ultimate branches of the panicle, subglobose, obovoid, a little longer than thick, yellow when full-grown but not quite ripe, shining, 14–17 mm. long; old calyx-segments persistent under the fruit, triangular-ovate, acute, 2 mm. long; flesh of old ripe fruit very thin; seed smooth, about 12 mm. long; endosperm bony, grooved.

Seedlings have rough-edged leaves green on both sides.

Type collected in savannas near Camagüey, Cuba, April 2–7, 1912 (*Britton, Britton & Cowell 13187*); also collected in the province of Camagüey (*Shafer 508, 1144, 2917*).

Anneslia enervis sp. nov.

A shrub or small tree 4 m. high, with slender, stiff, somewhat zigzag twigs sparingly pubescent when young, soon glabrous. Leaves very small; pinnae 2, the petiole and petiolules each about 1 mm. long, rather stout; pinnules 2 to each pinna, 2–3 mm. long, obovate, sessile, nerveless, shining, rounded at the apex, oblique at the base; heads nearly sessile in the upper axils, few-flowered; calyx campanulate, 1.5 mm. long, its teeth acute; corolla about 3 mm. long; stamens 6–7 mm. long; legume glabrous, 3–4 cm. long, 5 mm. wide, abruptly tipped at the apex, narrowed from below the middle to the base, the valves subcoriaceous.

Mountains of northern Oriente, Cuba; type from Camp La Gloria, south of Sierra Moa, *Shafer 8274*, December, 1910.

Not closely related to any species known to me, but somewhat resembling **A. colletioides** (Griseb.) Britton [*Calliandra colletioides* Griseb.] of low elevations in dry parts of the same province.

Belairia parvifoliola sp. nov.

A slender tree, up to 10 m. high, the twigs copiously armed with dark brown to black subulate spines 1.5–3 cm. long. Leaves short-petioled, the slender rachis puberulent or short-pubescent; leaflets 7–13, oblong to oblong-lanceolate, shining, nearly equally bright green and rather prominently veined on both sides, 8–13 mm. long, 2–3 mm. wide, the base inequilateral, the apex mucronate, the petiolules 0.5 mm. long; legume narrowly oblong, 10–12 mm. long, 3–4.5 mm. wide, narrowed at base and apex, strongly veined, borne on a filiform pedicel 6 mm. long or more.

Coastal woods, thickets and hillsides, southern Oriente, from Guantanamo Bay to Ensenada de Mora. Type, *Britton, Cowell & Shafer 13037*, Ensenada de Mora, March, 1912.

Meibomia Cowellii sp. nov.

Root thick and woody; stem slender, stiff, erect, hirsute, 3–8 dm. high, simple, or with few nearly erect hirsute branches. Leaves unifoliolate, short-petioled, oblong, linear-oblong or lanceolate, subcoriaceous, 2–10 cm. long, 2.5 cm. wide or less, obtuse and mucronulate at the apex, obtuse at the base, rather strongly reticulate-veined, finely short-pubescent above, villous-pubescent on the veins beneath, nearly equally green on both sides, the rather stout petioles 2–10 mm. long, the stipules lanceolate, striate, acuminate, 2–4 mm. long, the stipels subulate, about 3 mm. long; panicle narrow, nearly simple, long-stalked, 1–3 dm. long; bracts linear-subulate, 2.5–4 mm. long; pedicels filiform, puberulent, 4–7 mm. long; calyx 2.5–3 mm. long, campanulate, pubescent, lobed to about the middle, the lobes lanceolate, acute; corolla purple, 10 mm. broad; loment short-stipitate, 4–6-jointed, 2 cm. long or less, nearly equally constricted on both margins, the joints oval, about 4 mm. long and 2.5 mm. broad, loosely pubescent, indistinctly reticulate-veined.

Savannas and pine-lands, Pinar del Rio and Isle of Pines, Cuba. Type, *Britton, Britton & Cowell 10090*, from between Pinar del Rio and Coloma, March 16, 1911. Related to *M. angustifolia* (H.B.K.) Kuntze.

Kieseria cubensis sp. nov.

A tree, up to 13 m. high, the twigs stout, densely leafy toward the ends. Leaves coriaceous, oblong-obovate, 6–10 cm. long, 3 cm. wide or less, obtuse and rounded or somewhat emarginate at the apex, narrowed to the nearly sessile base; midvein impressed above, rather prominent beneath, the lateral veins obscure; peduncles solitary in the upper axils, stout, ancipital, 3–5 cm. long, 2-bracted at the top; bracts oblong, obtuse, about 1 cm. long; fruiting pedicels stout, subterete, 1–2.5 cm. long; sepals narrowly oblong, obtuse, 1.5 cm. long, entire; capsule about as long as the sepals, tapering into a stout-subulate beak about 6 mm. long.

Mountains of northern Oriente, Cuba. Type, *Shafer 8121*, from Camp La Gloria, south of Sierra Moa, December 1910. The genus is hitherto known only from South America. The Cuban species most resembles *Bonnetia anceps* Mart., of Brazil. The generic name *Kieseria* Nees, has priority over *Bonnetia* Mart., which is a homonym of *Bonnetia* Schreb.

33. A HYBRID PALM

On the sterile "savannas" north and east of Camagüey, Cuba, palms of two species of *Copernicia* abound. The one, *C. hospita*, has grey-green, thin foliage with spiny-toothed petioles about as long as the blades, and elongated, slender panicles; the other, *C. macroglossa*, has bright green, rigid foliage with very short, broad, unarmed petioles, the blades spiny-toothed on the margins of the outermost segments and on the upper surface of the ribs of the undivided part, the stout panicles not much longer than the leaves and the inflorescence with large bracts.

Of the two, *C. hospita* is the more abundant, *C. macroglossa* growing in colonies, more or less surrounded by it. At many places where the two grow together, plants intermediate in foliage characters occur, their leaves with spiny-toothed petioles of various lengths, the blades with sparingly spiny-toothed margins, otherwise smooth, and in color varying from green to grey, the panicles short and the inflorescence lacking the characteristic large bracts of *C. macroglossa*.

Field observations during four days with Mr. John F. Cowell, led us to the conclusion that these intermediate plants are of hybrid origin rather than a third species, as was first suggested.

34. PORTLANDIA [P. BR.] L., IN THE WEST INDIES

The type species is *Portlandia grandiflora* L.

1. Leaves cordate or subcordate at base, sessile or nearly so.
   Capsules 1 cm. long or less.
      Leaves orbicular, 2.5 cm. wide or less; corolla yellow; flowers sessile or very nearly so. — 1. *P. sessilifolia.*
      Leaves elliptic, 5–10 cm. long; corolla pinkish; flowers pedicelled. — 2. *P. nitens.*
   Capsules nearly 2 cm. long. — 3. *P. Harrisii.*
2. Leaves narrowed or rounded at the base, petioled.
   Leaves rounded or obtuse at the apex.
      Leaves elliptic. — 4. *P. elliptica.*
      Leaves obovate or oblanceolate.
         Capsule involucrate by bractlets. — 5. *P. involucrata.*
         Capsule not involucrate. — 6. *P. uliginosa.*
   Leaves acute or acuminate at the apex.
      Calyx-lobes oblong to ovate. — 7. *P. grandiflora.*
      Calyx-lobes linear to subulate.
         Capsule 1 cm. long or less; leaves 5–8 cm. long. — 8. *P. pendula.*
         Capsule 1.5–5 cm. long; leaves 6–15 cm. long.
            Capsule scarcely angled.
               Leaves ovate to elliptic; calyx-lobes linear; corolla 5–7 cm. long. — 9. *P. coccinea.*
               Leaves oblong-lanceolate; calyx-lobes long-subulate; corolla 2–2.5 dm. long. — 10. *P. Lindeniana.*
            Capsule distinctly angular.
               Capsule long-stalked, truncate. — 11. *P. daphnoides.*
               Capsule short-stalked, narrowed at both ends. — 12. *P. domingensis.*

1. **Portlandia sessilifolia** sp. nov.

A branching resinous shrub about 1.3 m. high, the young twigs short-pubescent, angular. Leaves thick-coriaceous, orbicular, 1.5–3 cm. long, sessile, subcordate, shining above, dull beneath, very indistinctly veined, the margins thick and revolute, their bases connected by a stipular sheath; inflorescence terminal, sessile, subcapitate, several-flowered; pedicels very short; calyx about 8 mm. long, very resinous, the linear lobes about as long as the tube; corolla tubular-campanulate, yellow, 1.5 cm. long; capsule oblong-obovoid, 5–6 mm. long.

Wet mountains of northern Oriente, Cuba. Type from Camp La Gloria, south of Sierra Moa, Cuba, December, 1910 (*Shafer 8190*).

A specimen from between Rio Yamaniguey and Camp Toa (*Shafer 4180*) with much larger elliptic leaves, 11 cm. long or less, but otherwise similar, may, perhaps, be referred to this species.

2. PORTLANDIA NITENS Britton, Bull. Torrey Club **39**: 10. 1912
Wet mountains of northern Oriente, Cuba.

3. PORTLANDIA HARRISII Britton, Bull. Torrey Club **39**: 8. 1912
On limestone rocks, Peckham Woods, Upper Clarendon, Jamaica.

To the original description the following may now be added from Mr. Harris' subsequent collections and observations: Corolla white, tinged with rose, urn-shaped, about 9 cm. long and 3.5 cm. wide at the mouth, fragrant, the tips of its lobes reflexed; pedicels and calyx-lobes usually claret-colored; calyx-lobes oblong, about 1.5 cm. long and 5 mm. wide; filaments pubescent below; anthers narrowly linear, yellow, nearly 2 cm. long, about half as long as the filaments (*Harris 11209*, Sept. 28, 1912).

4. **Portlandia elliptica** sp. nov.

A slender shrub 3.3 m. high, the young twigs, pedicels and calyx finely pubescent. Leaves elliptic, coriaceous, glabrous, or when young, slightly pubescent, 8 cm. long or less, 2–4 cm. wide, obtuse or rounded at the apex, narrowed at the base, dark green and shining above, bright green and rather dull beneath, the midvein prominent, the lateral veins obscure, the stout petioles 1 cm. long or less, the stipular sheath truncate; inflorescence terminal, sessile, few-flowered; pedicels slender, 5–8 mm. long; calyx 10–12 mm. long, its linear-lanceolate lobes longer than the tube; corolla narrowly campanulate, glabrous, ochroleucous, 2 cm. long; capsule obovoid, 12 mm. long.

Thickets on serpentine rocks, between Baracoa and Florida, Oriente, Cuba, March 15, 1910 (*Shafer 4332*).

5. PORTLANDIA INVOLUCRATA Wernham, Jour. Bot. **51**: 320. 1913
Wet parts of northern Oriente, Cuba. As remarked by Mr. Wernham, perhaps not of this genus; the corolla is unknown.

6. PORTLANDIA ULIGINOSA Wernham, Jour. Bot. **51**: 320. 1913
Between Rio Yamaniguey and Camp Toa, northern Oriente, Cuba.

7. PORTLANDIA GRANDIFLORA L. Syst. ed. 10. 928. 1759
Thickets and hillsides at lower and middle altitudes, in moist districts, Jamaica; St. Thomas (native?); cultivated in Grenada, and in St. Croix.

8. PORTLANDIA PENDULA C. Wright; Griseb. Cat. Pl. Cub. 126. 1866

Pendent on limestone cliffs, Pinar del Rio, Cuba.

A beautiful species, the pendent habit unusual, the branches sometimes drooping to a length of 2 meters or more; the flowers are fragrant.

9. PORTLANDIA COCCINEA Sw. Fl. Ind. Occ. 1: 384. 1797

P. coriacea Sw.; Spreng. Syst. 1: 708. 1825.

Thickets and hillsides at lower elevations in dry districts, southern side of Jamaica.

10. **Portlandia Lindeniana** (A. Rich.) Britton, nom. nov.

Gonianthes Lindeniana A. Rich. in Sagra, Hist. Cub. 11: 10. *pl. 49 bis.* 1850.

Portlandia gypsophila Macf. Fl. Jam. 2: 216; Griseb. Fl. Br. W. I. 324. 1861.

A tree, up to 8 meters high. Leaves chartaceous, oblong-lanceolate, pinnately veined, sharply acuminate at the apex, narrowed at the base, 12–20 cm. long, the petioles about 8 mm. long; flowers solitary in the axils; peduncles about 2 cm. long; calyx-teeth narrowly linear, 2.5–3.5 cm. long; corolla white, 2–2.5 dm. long, the narrowly campanulate limb much longer than the nearly cylindric tube; capsule oblong-obovoid, 4–5 cm. long, 15–18 mm. thick, smooth, not angled.

Wooded river and stream-banks at lower elevations, province of Oriente, Cuba; Jamaica? Cultivated in Martinique.

11. PORTLANDIA DAPHNOIDES R. Graham, Edinb. N. Phil. Jour. 1840–41: 206

Gonianthes Sagraeana A. Rich. in Sagra, Hist. Cub. 11: 11. 1850.

Portlandia longiflora Meisn.; Griseb. Cat. Pl. Cub. 126. 1866.

A shrub, about 1.3 meters high. Leaves thin, oblong, narrowed at both ends, rather dull green, pinnately veined, 7–13 cm. long, the petioles 1 cm. long or less; flowers solitary in the axils; peduncles 1–3 cm. long; calyx-lobes linear, 1.5–2 cm. long; corolla yellowish, about 2 dm. long, the campanulate limb about as long as the slender tube; capsule obpyriform, angled, truncate, 2.5–3 cm. long, slender-peduncled.

On rocks, especially along rivers and brooks, at lower and middle elevations, provinces of Oriente, Matanzas, and Pinar del Rio, Cuba.

The use of the name *P. daphnoides* for this species is taken from Graham's description, which does not agree with our specimens in all respects. I have not seen the type specimen. The shrub is abundant in the limestone hills of Pinar del Rio.

12. **Portlandia domingensis** sp. nov.

Foliage similar to that of the preceding species, but the petioles shorter, about 2 mm. long; flowers unknown; capsules short-peduncled, oblong, 5-angled, apparently somewhat fleshy, 4–4.5 cm. long, narrowed at both ends; calyx lobes linear, somewhat broadened at the base, about 1.5 cm. long.

Near San Pedro de Macoris, Santo Domingo, March 26, 1913 (*Rose, Fitch & Russell 4176*).

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CENTRAL AMERICAN MOSSES

ELIZABETH GERTRUDE BRITTON

AND

ROBERT STATHAM WILLIAMS

NEW YORK

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CENTRAL AMERICAN MOSSES

By Elizabeth Gertrude Britton and Robert Statham Williams

1. *Campylopus filifolius* (Hornsch.) Mitt.

Guatemala: Alta Verapaz, 3330a, Maxon and Hay, 1904; Alta Verapaz, 29, Cook and Doyle, 1905.

Costa Rica: Cartago, 506, Maxon, 1906.

2. *Campylopus subleucogaster* (C. Müll.) Jaeger.

Guatemala: Cubilquitz, 6652, H. von Turckheim, 1892.

Costa Rica: Vicinity of Coliblanco, 264, Maxon, 1906.

3. *Leucobryum antillarum* Sch.

Costa Rica: Coliblanco, 227a, Maxon, 1906.

4. *Syrrhopodon incompletus* Schwgr.

Syrrhopodon Hobsoni Hook. & Grev.

Syrrhopodon decolorans C. Müll.

Syrrhopodon Mohrianum C. Müll.

Syrrhopodon Sartori C. Müll.

Mexico: Liebman, Sartorius, etc.

Guatemala: Bernouille and Cario, Rio Pollochico, 3087, Maxon and Hay, 1904.

Honduras: Rio Platano, 690, Wilson, 1903.

5. *Hyophila reflexifolia* C. Müll.

Guatemala: Alta Verapaz, 411, Cook and Griggs, 1902.

6. *Macromitrium Tonduzii* Ren. and Card.

Costa Rica: La Palma, 481, Maxon, 1906.

7. **Macromitrium palmense** R. S. Williams sp. nov.

Pseudoautoicous: growing in deep tufts, the primary stems creeping, bare, the secondary erect, branching, without radicles, 5 or 6 cm. high; leaves densely imbricate, spreading, crispate in upper part; stem leaves 5 mm. long, linear-lanceolate, carinate, serrulate about one half down, smooth throughout or with a few low papillae on upper surface toward the base; excurrent costa slightly denticulate; leaf cells below long and narrow, the median in rows, about 6μ wide by 10 to 12μ long, with furrows between, or sometimes scarcely elongate in less distinct rows, the upper elongate, not in rows; perichaetial leaves a little shorter than stem leaves with longer cells above and more abruptly narrowed to the denticulate, excurrent costa; seta smooth, 1.5 to 2.5 cm. high; capsule smooth or nearly so, globose-pyriform, about 1.5 mm. high with stomata in several rows near base; lid not seen; peristome double, the outer of reddish-brown, densely papillose teeth, divided scarcely one half down, the inner of about the same height, a little paler, more or less irregularly divided; calyptra without hairs, slightly rough at apex; spores slightly rough, up to 35μ in diameter.

In habit much like *M. subcirrhosum* but with median leaf cells very different, leaf base scarcely papillose and costa distinctly excurrent.

Habitat: On tree trunk on open moist slopes.

Type locality: La Palma, Costa Rica, 480, Maxon, May 6, 1906.

8. *Macromitrium cirrhosum* (Hedw.) Brid.
Guatemala: Alta Verapaz, 3125, Maxon and Hay, 1905.
9. *Pohlia falcata* (Besch.) Broth.
Guatemala: Volcan de Agua, 3706, Maxon and Hay, 1905.
10. *Acidodontium megalocarpum* (Hook.) Ren. and Card.
Guatemala: Alta Verapaz, 430, Cook and Griggs, 1902; 3290, Maxon and Hay, 1905.
11. *Rhizogonium spiniforme* (L.) Bruch.
Guatemala: Alta Verapaz, 843, Cook and Griggs, 1902.
Costa Rica: Coliblanco, 263, Cartago, 499, Maxon, 1906.
12. *Philonotis sphaerocarpa* (Sw.) Brid.
Honduras: 487, Percy Wilson, 1903.
13. *Philonotis uncinata gracilenta* (Hpe.) Dismier.
Guatemala: San Felipe, 3550, Maxon and Hay, 1905.
14. *Polytrichum antillarum* Rich.
Polytrichum vernicosum Paris.
Guatemala: Baja Verapaz, 6930, von Turckheim, 1906.
Costa Rica: Coliblanco, 231, 337, La Palma, 423, Maxon, 1906.
15. *Orthostichidium pentagonum* (Hpe. & Ltz.) C. Müll.
Costa Rica: San José, 164, Cook and Doyle, 1903.
16. *Squamidium macrocarpum* (Spruce) Broth.
Costa Rica: Santiago, 82, Maxon, 1906.
17. *Papillaria nigrescens* (Sw.) Jaeg.
Guatemala: Chilion, Bernouille, 1867.
Costa Rica: San José, 146, Cook and Doyle, 1903; 146, Maxon, 1906.
18. *Phyllogonium viscosum* (P. Beauv.) Mitt.
Costa Rica: San José, E. S. Hyde, 1888.
Coliblanco, 236, Maxon, 1906.
19. *Phyllogonium fulgens gracile* Ren. & Card.
Costa Rica: San José, E. S. Hyde, 1888; Santiago, Aman Breues, 1901.
20. *Neckera Ehrenbergii* C. Müll.
Guatemala: Volcan de Agua, 3716, Maxon and Hay, 1905.
21. *Porotrichum* sp. ? (young plants too small to name).
Costa Rica: La Palma, 384a, Maxon, 1906.
22. *Entodon stenocarpus* (Br. & Sch.) Jaeg.
Costa Rica: San José, 165, Cook and Doyle, 1903.

23. *Fabronia flavinervis* C. Müll.

Guatemala: San Felipe, 3508, 3510a, Maxon and Hay, 1905.

24. *Fabronia polycarpa* Hook.

Panama: Between Salanca and Chiquin, O. F. Cook, 1905.

25. *Pilotrichum bipinnatum* (Schwgr.) Brid.

Guatemala: Alta Verapaz, 500, Cook and Griggs, 1902.

26. **Isodrepanium** (Mitt.) E. G. Britton gen. nov. Fig. 1.

Fig. 1. *Isodrepanium lentulum* (Wils.) E. G. Britton.

Lepidopilum Sect. *Isodrepanium* Mitt. Journ. Linn. Soc. 12: 369. 1869.

Among our Jamaica collections we have fine specimens of a moss which we had difficulty in referring to any genus known to us from the West Indies and this difficulty still remains for according to Brotherus* it cannot be a *Homalia* because the leaves have porose cells and although they are ecostate they are not entire and hence do not fit with *Euhomalia* or *Spathularia*. According to Mitten this has been described as a subgenus of *Lepidopilum* with one species *L. membranaceum* (C. M.) Mitt. characterized by its equally falcate, scythe or scimitar-shaped leaves. There is but one species, but it is listed in three genera in Paris Index, as *Homalia*, *Lepidopilum* and *Neckera*. The identity of these species has been determined by consulting type material of each and as the fruit has not been described we give the following characters:

Isodrepanium (Mitt.) E. G. Britton gen. nov.

Plants occasionally a foot long, pendent on trees. Stems slender, regularly pinnate or bipinnate, branches 1–14 cm. long. Leaves glossy, imbricate, falcate, acuminate, serrate, ecostate; cells porose. Dioicous. Seta 4 cm. long, slender, flexuose; capsule nodding-ovoid; peristome double, without cilia.

Type species: *Homalia lentula* Wils.

Isodrepanium lentulum (Wils.) E. G. Britton new combination.

Homalia lentula Wils. Ann. Mag. Nat. Hist. **20**: 379. 1847.

Hookeria membranacea C. M. Syn. Musc. **2**: 200. 1851.

Lepidopilum membranaceum Mitt. Journ. Linn. Soc. **12**: 369. 1869.

Neckera falcifolia R. & C. Bull. Soc. Roy. Bot. Belg. **32**: 184. 1893.

Homalia membranacea C. M. Hedwigia **37**: 266. 1898.

Neckera lentula Broth. in E. & P. Pfl. 1^3: 842. 1906.

Stems pendent, irregularly branched, reaching a maximum of 30 cm. in length with branches pinnate or bipinnate, often 10–15 cm. long; leaves glossy green, crowded, flexuose, 1.5 mm. long, falcate-acuminate, ecostate; apex recurved; margins unequally and finely serrate; base oblique, unequal, slightly auriculate on one side, basal cells yellow, enlarged, all femur-shaped and porose, with thick walls. Perichaetial leaves longer pointed, almost entire. Dioicous. Seta 4 cm. long, slender, flexuose, red; capsule 2–3 mm. long, ovoid, horizontal; peristome double, yellow; teeth trabeculate, with narrow projecting lamellae,

* E. and P. Pflanzenfam. fasc. 226: 847. 1906.

slender and papillose at apex; endostome paler, smooth, segments carinate and perforate, cilia none; walls thickened, cells small, irregularly hexagonal; spores smooth, 16–18 μ. Lid and calyptra not seen.

TYPE LOCALITY: Port Royal, Jamaica. "Mc Nab."

DISTRIBUTION: High Mountains of Jamaica, Morce's Gap, John Crow Peak, New Haven Gap and Sir John and Summit, St. Catharine's Peak; Cuba, Sierra Maestra and Mt. Torquino; Porto Rico, Luquillo Mts.; St. Vincent, H. H. Smith; Barbadoes, Parker; Trinidad, Crüger. Guatemala, Alta Vera Paz, H. von Turckheim 1149, Cook and Griggs 512, with fruit. Costa Rica, Pittier 9642; New Granada and Mt. Abitana, Andes of Quito, Spruce 740.

Funck and Schlim, 370 from Caracas, Venezuela, is not this species but a true *Homalia*.

Homalia glabella (Sw.) Mitt. with which it has been confused by Mitten also has its type locality in Jamaica but that species grows on rocks, in shade, is a smaller plant, with nearly simple branches, obtuse or shortly apiculate leaves which are shortly bicostate and without porose cells. Its distribution is from Jamaica, Porto Rico to Guadeloupe, and from Mexico and Guatemala to Costa Rica.

27. *Callicostella pallida* (Hornsch.) Jaeg.

Guatemala: Alta Verapaz, 388, Cook and Griggs, 1902.

28. *Callicostella Oerstediana* C. Müll.

Guatemala: Rio Pollochico below Panzos, 3086, Maxon and Hay, 1904.

29. *Harpophyllum aureum* (Lam.) Spruce.

Costa Rica: La Palma, 400, Maxon, 1906.

30. *Hypopterygium Tamarisci* (Sw.) Brid.

Costa Rica: Santiago, 116, Coliblanco, 338, Maxon, 1906.

31. *Helicophyllum torquatum* Brid.

Guatemala: 3538, Maxon and Hay, 1905.

32. *Rhacopilum tomentosum* (Sw.) Brid.

Rhacopilum latistipulatum Cardot

Rhacopilum angustatum Sch.; Besch.

Rhacopilum tomentosum longe-aristatum C. Müll.

Nicaragua: Volcan Mombacho, 2367, Baker, 1903.

Guatemala: Alta Verapaz, Cook, 1905; San Felipe, 2536, Maxon and Hay, 1905.

Costa Rica: Santiago, 89, Maxon, 1906.

33. *Thuidium miradoricum* Jaeg.

Costa Rica: Cartago, 499a, Maxon, 1906.

34. *Mittenothamnium Langsdorfii* (Hook.) Cardot

Costa Rica: La Palma, 384, Maxon, 1906.

35. *Mittenothamnium megapalmatum* (C. Müll.) Card.

Guatemala: Alta Verapaz, 325, Maxon and Hay, 1905.

36. *Mittenothamnium nicaraguense* (Broth. ined.) E. G. B. comb. nov.

Nicaragua: Volcan Mombacho, 2501, 2514, Baker, 1903.

37. *Mittenothamnium reptans* (Sw.) Card.

Costa Rica: Coliblanco, 339, 348, La Palma, 372, 374, Maxon, 1906.

38. *Mittenothamnium Salleanum* (Besch.) Card.

Guatemala: Godman and Salvin in Hb. Mitt.

39. *Mittenothamnium substriatum* (Mitt.) Card.

Mexico: (Found without collector or locality in Hb. Mitt.) Det. by Max Fleischer.

40. *Ectropothecium apiculatum* (Hornsch.) Mitt.

Guatemala: Alta Verapaz, 93, 258, 383, Cook and Griggs, 1902.

Costa Rica: Finca Navarro, 619, Maxon, 1906.

41. *Ectropothecium globitheca* (C. Müll.) Mitt.

Nicaragua: Volcan Mombacho, 2368, 2520, C. F. Baker, 1903.

42. *Ectropothecium pseudo-rutilans* (C. Müll.) Paris

Nicaragua: Volcan Mombacho, 2366, C. F. Baker, 1903.

43. *Isopterygium miradoricum* (C. Müll.) Jaeg. (ex descriptio)

Guatemala: Puerto Barrios, 3072, 3076, 3078, Maxon and Hay, 1904.

44. *Isopterygium pusillum* Ren. & Card.

Honduras: Puerto Sierra, 506, P. Wilson, 1903.

Costa Rica: La Palma, 371, Maxon, 1906.

45. *Isopterygium trichopelma* (C. Müll.) Paris

Costa Rica: Coliblanco, 250, Maxon, 1906.

46. *Taxithelium planum* (Brid.) Mitt.

Honduras: Puerto Sierra, 507, 556, P. Wilson, 1903.

Guatemala: Alta Verapaz, 3216, Maxon and Hay, 1905.

47. *Vesicularia amphibola* (Spr.) Broth.
Guatemala: Alta Verapaz, 410, Cook and Griggs, 1902.
48. *Vesicularia vesicularis* (Schwgr.) Broth.
Guatemala: Mazatenango, 3494, Maxon and Hay, 1905.
49. *Pterigonidium pulchellum* (Hook.) Broth.
Honduras: Puerto Sierra. 499, P. Wilson, 1903.
Guatemala: Puerto Barrios, 3066, Maxon and Hay, 1904.
50. *Sematophyllum caespitosum* (Sw.) Mitt.
Costa Rica: Santa Clara, 604, 611, Cook and Doyle, 1903.
51. *Sematophyllum galipense* (C. Müll.) Mitt.
Honduras: near Puerto Sierra, 290, P. Wilson, 1903.
52. *Sematophyllum Lindigii* (Hpe.) Mitt.
Costa Rica: Coliblanco, 244, 265, 336, 346, Maxon, 1906.
53. *Trichosteleum fluviale* (Mitt.) Jaeg.
Guatemala: Puerto Barrios, 3077, Maxon and Hay, 1904.
54. *Trichosteleum microcarpum* Brotherus.
Sematophyllum microcarpum Mitt. Jour. Linn. Soc. 12: 493. 1869, in part.
Nicaragua: Volcan Mombacho, 2497, C. F. Baker, 1903.

In Mitten's herbarium we find a specimen labeled *Leskea microcarpa* "fl. Ind. occ. Swartz. Hb. Hooker." This must have been a manuscript name of Swartz, because it does not occur in his *flora Indiae occidentalis*, as stated. It is evidently the type of *Sematophyllum microcarpum* Mitt. which he placed in the section *Trichosteleum* (p. 492), but it does not agree with other species of this genus, because although there are occasional small obscure papillae on a few of the young leaves, most of the leaves are entirely smooth and the specimen agrees with *Sematophyllum xylophilum* Mitt. (l. c. p. 490) to which it must be referred as a synonym.

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 166

STUDIES OF PLANT GROWTH IN HEATED SOIL

GUY WEST WILSON

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STUDIES OF PLANT GROWTH IN HEATED SOIL

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STUDIES OF PLANT GROWTH IN HEATED SOIL

GUY WEST WILSON

(*Laboratories of the New York Botanical Garden*)

(WITH PLATES 3–5)

Introduction. The problem of the effect of heat on soils is one of interest alike to the chemist and the botanist. The effect of heat on the soil elements themselves forms a prolific field for investigation, while the resultant changes in the growth of plants present a no less interesting series of problems. In a recent paper Seaver and Clark[1] have discussed some of the problems in each of these fields and presented a review of the literature of the subject to date. As the present paper represents work done in the same laboratory on the same line of problems, and following the same general methods of these workers, no further discussion of the previous work on the subject appears to be necessary, except in connection with the analysis of the results of the experiments detailed here.

Experimental. General plan. In all of the experiments described below the soil was the ordinary unfertilized soil of Bronx Park. While this is not rich in plant food and, from many standpoints, is not so satisfactory for such work as a richer agricultural soil, the results obtained from percolation experiments corresponded with those described by Seaver and Clark, except that the lighter color of the percolates indicated a lower percentage of soluble matter. For each experiment twelve four-inch pots were filled with sifted soil and divided into groups of three each. One group was used as the check and the others heated in a dry oven for two hours at temperatures of 95°, 135°, and 175° C., respectively. From each of these groups one pot was used for percolation and the others planted with the various crops to be grown, ten seeds being sown in

[1] Seaver, Fred J., and Clark, E. D.: Biochemical studies on soils subjected to dry heat, Biochem. Bull., 1: 413–427 (pl. 7); 1912.

each pot. After germination these were divided to form two complete series upon which observations were made. Photographs were made as developments suggested (Plates 3–5).

Experiment I. *Buckwheat.* The first culture was photographed when the seedlings were about four days old, again after the lapse of a week, and lastly at flowering time. A comparison of the photographs shows in the early part of the period of growth (Fig. 1) a slight acceleration in the pots heated to 95°, in the one heated to 135° it was somewhat retarded, and in the one heated to 175° there was marked retardation in germination and stunting in growth. The plants on the soil heated to the higher temperatures were increasingly more unhealthy in color and decreased in vigor. After the lapse of a week the same relative conditions were still apparent (Fig. 2). At flowering time the results were quite marked (Fig. 3). The plants in the pot heated to 95° came into bloom about five days earlier than did the check, and bloomed more profusely. The photograph was taken about a week after the first flowers appeared. At this time the check was second in vigor to the growth in the pot which had been subjected to a heat of 95°, while the plants on the soil heated to 135° lacked vigor and only one plant produced flowers, and that sparingly. The plants on the soil which had been heated to 175° produced no flowers, were of low vitality, and much stunted in growth. The following table shows in detail the results of this set of cultures.

Temperature of soil	Seeds germinated in 4 days	Seeds germinated in 11 days	Plants living at flowering time	Plants that flowered	Number of flowers produced
Check	8	8	8	4	11
95°	8	8	8	6	42
135°	5	7	6	1	4
175°	3	6	3	0	0

From this it appears that, so far as buckwheat is concerned, slight heating of the soil is beneficial, while high heat retards growth very seriously, and produces weakened plants.

Checks were run on this experiment and the results agreed with those given above, except that none of the earlier cultures were kept until flowering time. No fungous disease appeared on the plants, although various fungi developed on the soil. While no especial attention was given to these, it may be mentioned in this connection that the most abundant were *Pyronema* and a species of *Monilia*. A racemose species of *Mucor* appeared in one pot. These fungi did not appear to interfere with the germination of the buckwheat or of the small grains used in the other experiments of this series. The fungi were always more abundant on the soil which had been heated to the higher temperatures, while none appeared on the check pots.

EXPERIMENT II. *Wheat.* The first planting of wheat was allowed to grow about twelve days before being photographed (Fig. 5). The plants in all the pots showed good growth, there being a slight advantage with the check in vigor and color, while that in the soil which had been heated to the lowest temperature (95°) was almost as healthy and vigorous. In the two high temperature pots the growth was very rank and weak. Although not quite so tall, the plants in these two pots fell down or "lodged" considerably in the 135° pot, and very noticeably so in the 175° pot. The plants in these two pots behaved much as does grain grown on a soil too rich in humus. The later growth of this series, while not photographed, was quite interesting. The two low-temperature pots (check and 95°) were almost equal in growth and vigor, the 95° one having a slight advantage in vigor and color, but not outgrowing the check in height. The other two pots remained stunted and, after the lapse of a month, showed appreciable inhibition as compared to the others. Indeed, the one which had been subjected to the highest temperature grew but little in height after the second week. This work was twice repeated with results similar to those just described.

One of these series was photographed at about five days after germination (Fig. 4). The plants on soil which had been heated to 95° showed a very slight advance over the check in color, but not quite such a good growth. The pot which had been subjected to a heat of 135° showed some retarded germination, giving a very uneven growth, while that subjected to a temperature of 175° was markedly retarded, showing only a slight growth as compared with the others. The work on wheat was seriously interfered with by rust (*Puccinia graminis*) and mildew (*Erysiphe graminis*), both of which attacked the weakened plants on the soils which had been heated to the higher temperatures in preference to the more vigor-

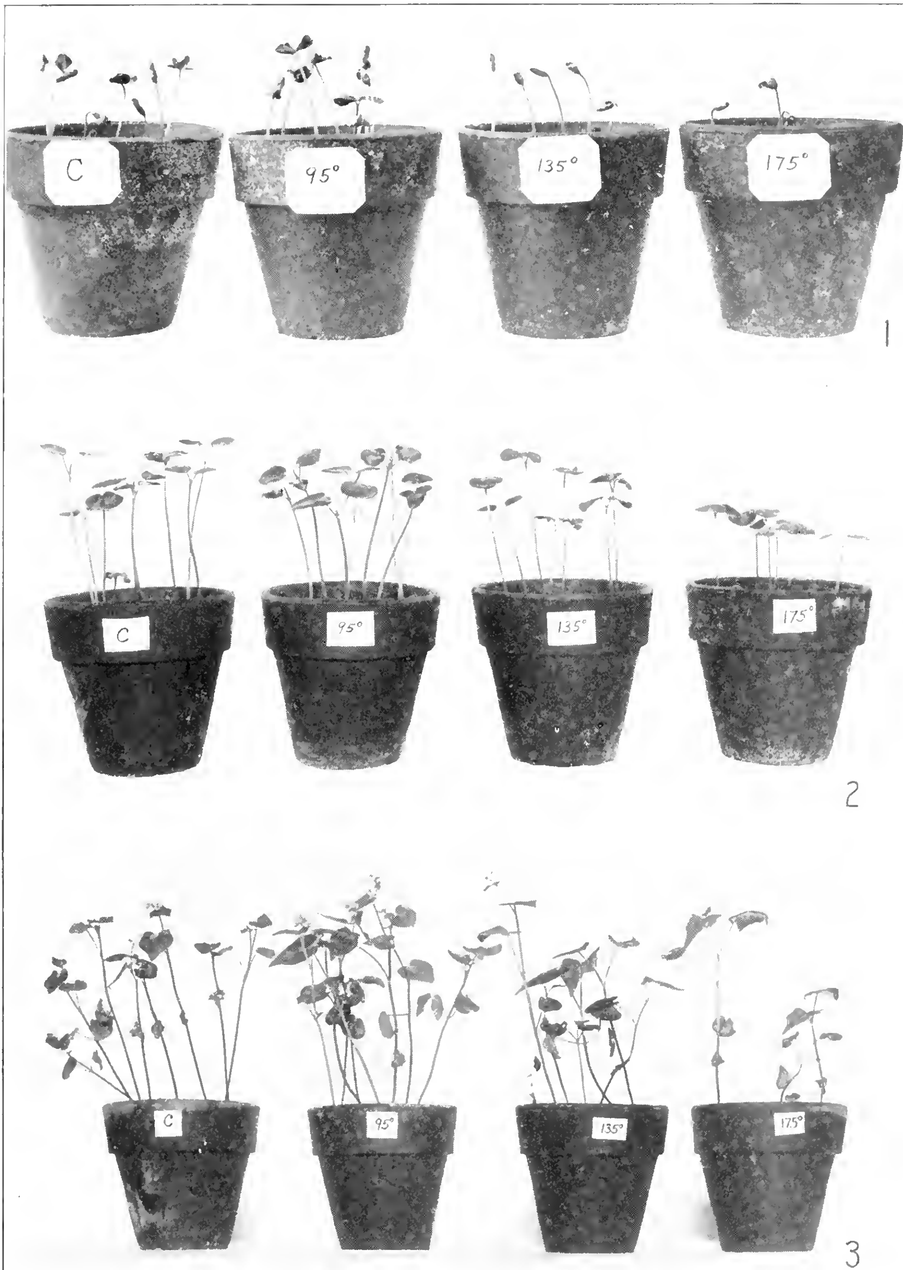

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Fig. 1: Buckwheat seedlings four days after germination; *Fig. 2:* Buckwheat seedlings one week older than those in Fig. 1; *Fig. 3:* Buckwheat at flowering time.

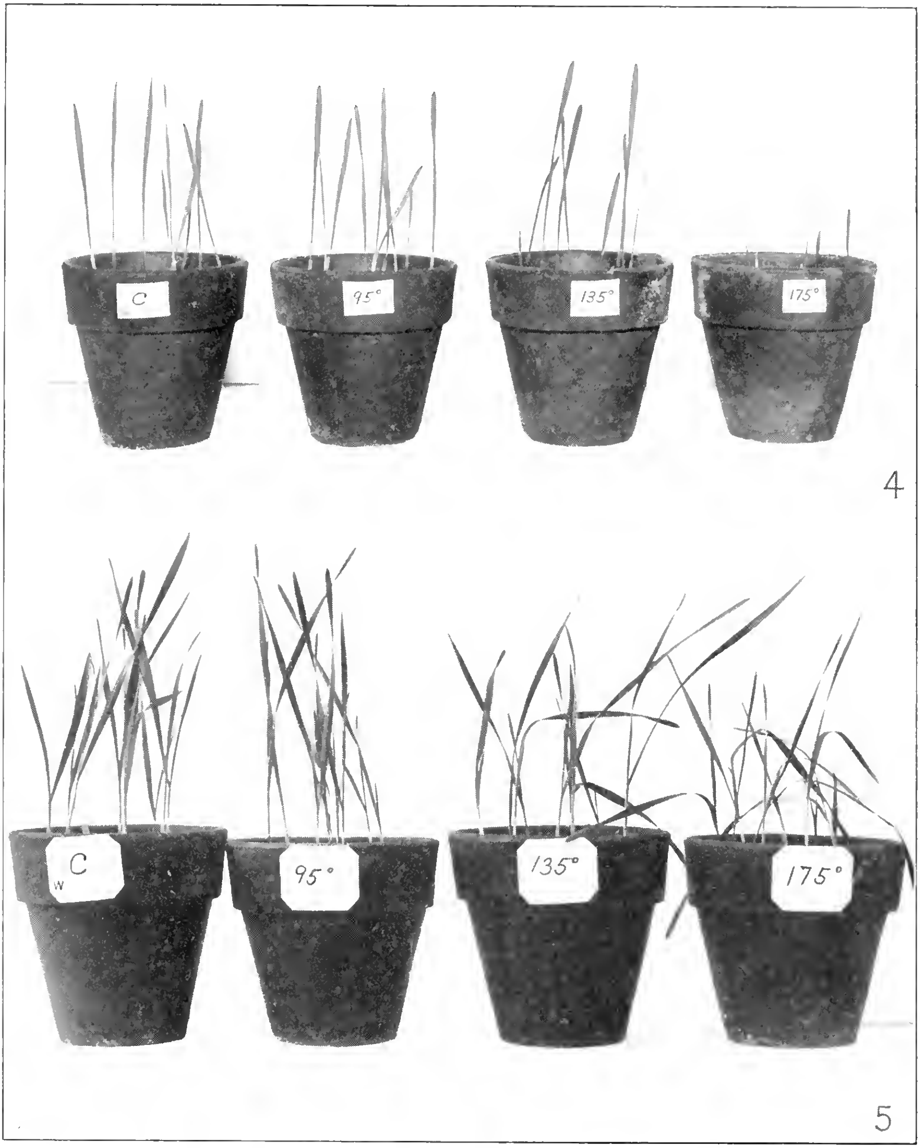

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Fig. 4: Wheat seedlings five days after germination; *Fig. 5:* Wheat seedlings from another culture two weeks old.

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Fig. 6: Rye seedlings one week after germination; *Fig. 7:* Rye seedlings—the same culture after the lapse of one week; *Fig. 8:* Barley seedlings at the end of the first week.

ous plants on the lower heated soils. For this reason it was impracticable to keep the pots under observation until flowering time.

EXPERIMENT III. *Rye.* The plants in this experiment were first photographed at the end of a week (Fig. 6) and again at the end of the second week (Fig. 7). The plants were all very healthy, highly colored and sturdy. In the low-temperature pot (95°) the plants were slightly more colored than those of the check, and showed a better and more even growth. In the two higher-temperature pots the growth was retarded and the plants were weaker, but their heightened color showed the effect of the higher percentage of soluble matter in the soil on which they were grown. Germination was seriously retarded by heating to 175°. From the various cultures made of rye it would appear that there was a slight acceleration of growth on the soil subjected to a temperature of 95°, while the higher temperatures showed a proportionate retardation. These plants were severely attacked by mildew, those on the soils which had been heated to the higher temperatures suffering most seriously.

EXPERIMENT IV. *Barley.* At the end of the first week, when the barley plants were photographed (Fig. 8), germination was about equal in all the pots. The rate of growth varied considerably. The plants on the soil that had been heated to 95° were slightly taller than the check, those on the soil of the next member of the series (135°) were slightly retarded in growth, and those on the last one (175°) were markedly retarded in growth. While no repetition of this experiment was attempted, the results indicated that the growth of barley was affected less than that of any of the small grains grown in these soils, yet the highest temperature caused a serious retardation. It is probable that the optimum for barley is slightly higher than for the other plants which were used in this series of experiments.

General discussion. While the soil used in these experiments was, from the agricultural standpoint, a very poor loam, all the crops grown were those which might be considered best adapted to the type of soil used. Barley, alone of the series, is usually regarded as demanding a soil which might be termed rich, while buckwheat and rye are noted for their ability to grow on soils low in plant food. Wheat, however, demands a richer soil than the last named crops.

From the work of Seaver and Clark it appears that the materials rendered soluble by subjecting soil to dry heat show properties of sugars and organic acids; others have obtained results suggestive of soils composed almost entirely of humus, the acid nature of which is well known. It is possible that the preference of certain plants for peaty soils or burned-over areas may be due to the acidity of these soil types. Certain facts observed by the present writer in the course of the experiments described above, as well as field observations on the same crops in swamp soils which were very rich in humus, appear to bear out this theory. Buckwheat is usually grown on poor soil, where it thrives. The writer has seen a number of attempts to grow it on swamp land with uniformly unsatisfactory results. Comparable to this is the effect of subjecting the soil to a very high temperature. Wheat is also usually grown on a loamy soil of a rather low humus content as compared with swamp lands. When grown on the latter it has a tendency to produce weak stems with a consequent "lodging" of the grain. This is at least true in regard to certain varieties. The behavior of the plants on the soils which had been subjected to the higher temperatures suggests analogous results, as the leaves were flaccid and lacking in normal rigidity.

Throughout the entire series of experiments delayed germination and retarded growth characterized all the crops grown on soil subjected to a temperature of 175°. These results were quite marked. Similar results, but in a less pronounced degree, were noted in cultures on soil heated to 135°. Not only was the growth of these plants retarded, but their susceptibility to disease was increased.

The writer's experiments agree with those of Seaver and Clark in indicating that soils subjected to a low degree of heat (120° C., or less) show an accelerated growth of green plants and a retardation of fungous growth, while soils heated to a higher temperature give results which are the reverse, *i. e.*, retarded growth of green plants and accelerated growth of fungi. These results also accord in the main with more recently published results obtained by other workers, although on the surface some of these may appear to differ.

Schreiner and Lathrop[2] have conducted extensive studies on the chemistry of steam-heated soils and their relation to plant growth. They autoclaved the soil samples at a temperature of 135° C., and under a pressure of 30 pounds, for a period of three hours. As a result of this treatment they note increased amount of soluble matter in the soil extract and retarded plant growth, both of which are to be expected under the circumstances. All the materials found in unheated soils were present in the heated samples except nucleic acid which was broken down and united with some of the protein substances to form new compounds. The effect on plant growth is explained by the fact that while beneficial elements are present they are overbalanced by harmful compounds. Upon the balance of these elements, then, depends the results upon plant growth. "This balance is influenced by cultural treatment, fertilizers, liming, crop growth, or crop rotation, etc., as well as by steaming."

Articles have also appeared, from time to time, upon the effect of soil sterilization as practiced commercially. This is accomplished by forcing steam into the soil *in situ*. While the nominal temperature to which the soil is subjected by this treatment is quite high, there are great difficulties in the way of securing an even distribution of the steam in the soil-mass. The results are a very uneven sterilization, the after effects of which are quite different from those obtained by other methods where the penetration is subject to less fluctuation. In this type of sterilization the prime object is to rid the soil of the nematodes, insect pests, injurious fungi and bacteria which may have accumulated in it. From this standpoint the method of soil treatment is satisfactory in so far as it reduces the ravages of these pests on the subsequent crop.

A summary of our knowledge along these lines has recently been published by Stone,[3] who noted acceleration in the growth of lettuce and cantaloupes on steam-heated soil, when it was rich in organic matter, while the results were bad on poor soil. The gross effect of such treatment on plant growth is apparently analogous to that following subjection of the soil content of the plot to a more *evenly*

[2] Schreiner, O. S., and Lathrop, E. C.: The chemistry of steam-heated soils, *U. S. Dept. Agric., Soils Bull.*, **89**: 1–37; 1912.

[3] Stone, G. E.: The present status of soil sterilization, *Ann. Rep., Mass. Agr. Expt. Sta.*, **24**: 121–125 (pl. 1, 2); 1912.

distributed heat at a lower temperature. The effects of tillage are also to be taken into account as possibly causing a more equal distribution of the elements after steam sterilization. Stone expresses the opinion that the acceleration which he and others have noticed in the case of steam-sterilized soils in market gardening districts is due rather to the chemical changes within the soil than to any modification of its flora or fauna.

Lodge and Smith[4] have studied the effects of steam heat on soils in relation to the growth of bacteria as well as green plants. They used soil sterilized for 45 minutes under a pressure of 15 pounds of steam at a temperature of 125° C. Percolates of these soils were sown with *Bacillus subtilis.* Their experiments showed that where the soils were rich in organic matter steam heat increased subsequent bacterial growth, while in soils deficient in organic matter such growth was retarded. They report similar results with green plants, and emphasize the fact that in the soil used protozoans were not present to an appreciable extent.

Various attempts have been made to explain the observed effects of soil-heating upon subsequent plant growth. Russel and Hutchinson[5] attribute the changes observed by them to the destruction of the soil-inhabiting protozoa and the consequent greater activity of the soil bacteria. Lyon and Bizzell[6] hold, on the other hand, that the results are due entirely to the chemical changes in the soil itself. Bolley[7] concludes that the most important factor is the destruction of the fungi and bacteria which are present in the soil and which might produce disease in the crops grown. Seaver and Clark consider "that the whole question of the effects of heating soils is a very complex one and one in which the experimenter's interpretation of results depends upon his training and point of view; whether it be bacteriological, chemical or phytopathological. It is very

[4] Lodge, C. A., and Smith, R. G.: Influence of soil decoctions from sterilized soils upon bacterial growth, *Ann. Rep., Mass. Agr. Expt. Sta.,* **24**: 126–134; 1912.

[5] Russel and Hutchinson: The effect of partial sterilization of soils on the production of plant food, *Jour. Agr. Sci.,* **3**: 111–114; 1909.

[6] Lyon, T. L., and Bizzell, J. A.: Effect of steam sterilization on the water-soluble matter in soils, *Bull. Cornell Agr. Expt. Sta.,* **275**; 1910.

[7] Bolley, H. L.: Interpretation of results in experimentation on cereal cropping methods after soil sterilization, *Science,* **33**: 229–234; 1912.

likely that the truth of the matter lies somewhere on the borderlines of the three sciences indicated." Beyond this we are not at present prepared to go, save to remark that the widely divergent soils studied severally by these observers probably contained substances which justify the conclusions of each. If each of these investigators had studied all the soils referred to in these papers, the interpretation of the results obtained might have been more harmonious.

Summary of general conclusions. All the plants used in this work showed a slight acceleration of growth and vigor on soil which had been heated to a temperature of 95° C. In the case of buckwheat, acceleration was quite marked.

All the plants used in these experiments showed a retardation of growth on soils subjected to a heat of 135° or 175° C., the retardation being especially marked for plants grown on soil heated to the higher temperature.

Plants grown on heated soil were more susceptible to attack by parasitic fungi than those grown on unheated soil, although the susceptibility to such attacks did not increase proportionately as the growth of the host decreased.

Soil fungi grew more abundantly on the soils which had been subjected to high temperatures, in one instance seriously interfering with the experiment.

The effect of heating soils upon the crop grown varies with the temperature to which the soil is subjected, the kind of soil used, and the nature of the crop grown upon it.

In conclusion most hearty thanks are due to Professor William J. Gies, to Dr. Fred J. Seaver and to Dr. Ernest D. Clark for their suggestions and advice during the progress of the work.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 167

THE IDENTITY OF THE ANTHRACNOSE OF GRASSES IN THE UNITED STATES

GUY WEST WILSON

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1914

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THE IDENTITY OF THE ANTHRACNOSE OF GRASSES IN THE UNITED STATES

GUY WEST WILSON

A very common and wide-spread grass inhabiting fungus currently known as *Colletotrichum cereale* Manns has frequently come to the attention of the writer. That a species so wide-spread and so conspicuous should have escaped the notice of taxonomists until within the last five or six years has been the cause of considerable surprise. It was, therefore, with no small interest that the collections at the New York Botanical Garden were examined with a view to determining the true status of this species. After a cursory examination of Saccardo's Sylloge and of this material it appeared to be worth while to study the problem more seriously. In publishing *C. cereale* the reference to past literature is embodied in the following quotation:[1] "In the study of an organism such as this one, systematic difficulties are met with. Systematic mycologists in the past have not covered precisely all the points that prove to be essential in generic distinctions. This has resulted in the description of certain organisms in such a way as to be referable to any one of two or more genera. Such difficulties are met in the genera Colletotrichum (Melanconieae), Vermicularia (Sphaeropsideae) and Chaetostroma (Hyphomyceteae) . . . . . . This anthracnose partakes more closely of the genus Colletotrichum, hence the organism has been provisionally thrown into this genus and given the name *Colletotrichum cereale*, n. sp."

The results of the studies of the available specimens of grass anthracnose are given in detail under the various names under which the specimens were found in the herbarium.

1. *Dicladium graminicolum* Cesati

This species, which is the type of a new genus, was described from Vercelli, Italy, on stems of *Echinochloa Crus-galli* and *Zea Mays*. Cotype material was exmained. The conidia and setae are the same as those of *Colletotrichum cereale*, the former averaging about $20 \times 4\mu$, while the latter are about 115μ long. No other material so named was seen. The species was transferred by Saccardo to the genus Steirochaete.

[1] Selby and Manns, Ohio Agr. Expt. Sta. Bul. 203, pp. 206, 207. 1909.

2. *Psilonia apalospora* Berk. & Curt.

This name was given to material issued in exsiccati by Ravenel, on dead stalks of *Zea Mays* from South Carolina. No diagnosis was given to accompany the specimens. As the specimen at hand had reposed on an unprotected page without an envelope for over half a century the setae were so broken that they could not be measured, but the acervulus has the structure of *Colletotrichum cereale*. The conidia measure 20 to 23 x 3 to 4μ. This is well within the limits of variation of the Colletotrichum in question. Saccardo[2] pointed out the identity of this species with *Colletotrichum lineolum*. Other specimens so named were examined on *Zea Mays* (New Jersey, West Virginia) and on *Panicum sanguinale* (New Jersey). The former host appears only in the form of dead stalks, while the latter was evidently living material.

3. *Vermicularia culmigena* Cooke

This species was also issued undescribed by Ravenel on *Tripsacum dactyloides* from South Carolina. The material is a Colletotrichum with conidia and setae well within the limits of size and form of those of *C. cereale*. *Vermicularia culmigena* Desmaz. is a true Vermicularia which is found in Europe on Dactylis and Arrhenatherum.

4. *Vermicularia Holci* Sydow

Described from Germany on *Holcus lanatus*. Only cotype material was seen. This is a Colletotrichum with very small acervulae and conidia about 19 x 3.5μ. It is certainly not distinct from the species under consideration.

5. *Vermicularia Lolii* Roum.

Described from France on *Lolium perenne*. This a Colletotrichum with conidia showing a much greater range in size than the original description of 22 to 26 x 5.6μ would indicate. While no other material except the cotype was seen the species is certainly not distinct from *Colletotrichum cereale*. However those mycologists who recognize "microspora" and "macrospora" varieties would probably give it subspecific rank.

6. *Vermicularia Melicae* Fuckel

Described from Europe on *Melica uniflora*. The original description is not sufficiently explicit to differentiate the species, and as no specimen

[2] Michelia **2**: 375. 1881.

named by Fuckel was at hand its exact status cannot be determined. The material from Germany on *Melica uniflora* and *Calamagrostis epigeum* which was distributed by Sydow belongs to *Colletotrichum cereale*. The conidia average about 20 x 3.5μ.

7. *Vermicularia sanguinea* Ellis & Halsted

This species is based on material collected at Ames, Iowa, by Dr. B. D. Halsted, on a cultivated species of Panicum of European origin. The original spore measurements of 20 to 22 x 6μ is entirely too large, as the type specimen shows a range of 18 to 22 x 4 to 6μ. While the spores are a trifle broad in proportion to their length the discrepancy does not appear to be sufficient to warrant its retention as a distinct species. The chief distinction appears to be the reddish margin of the infected area, which may be due rather to the chemical composition of the leaf than to a difference in the parasite. Other specimens so named are on *Panicum Crus-galli* (Kansas) and on *Sorghum* sp. (Alabama). The species was later transferred to Colletotrichum.

8. *Vermicularia graminicola* Westend.

The cotype material of this species which was examined was not in a condition to warrant an opinion as to the identity of the fungus, as no acervulae were found. However other European material issued by Allescher and Schnabl and by Roumeguere under this name is a true Vermicularia. American material which was placed under this name, but which is in reality identical with *Colletotrichum cereale*, was examined on *Anthaenantha rufa* (Florida), on *Cenchrus tribuloides* (Delaware), and on *Poa* sp. (New Jersey).

9. *Vermicularia affinis* Sacc. & Briard

The type of this species was collected in France on some undetermined species of grass. As no authentic material was at hand for study its identity has not been established, but the description would indicate a true Vermicularia. Material so named from Mississippi on both *Andropogon Hallii* and *Panicum Crus-galli* is a Colletotrichum which agrees in every respect with *C. cereale*.

10. *Vermicularia* sp.

Undetermined material so labeled on *Dactylis glomerata* (Mississippi) and on *Arundinaria* sp. (Alabama) evidently belong to the species of Colletotrichum under consideration. While setae and conidia agree in size, the conidia from Arundinaria are in the main somewhat less curved than is usual in *C. cereale*. The difference, however, does not appear to be sufficient to warrant the separation of this form as a distinct species.

11. *Colletotrichum lineola* Corda

This species was first described from dead Umbelliferous stems, but later almost any species of Colletotrichum with elongate acervulae was referred to it. As a result *C. lineola* "Aut." is a species of astonishing variability in conidial and other characters, to say nothing of its extreme diversity of hosts. As Corda's figure is such as to give no warrant for supposing that his fungus and the grass-inhabiting forms which have been so named are the same species it is impossible to include this name among those of the grass anthracnose. In the specimens on grasses which have been referred to this species the conidia average 20 to 22 x 2 to 4μ, and the setae about 100 to 150μ long. This places the material among that which must be considered as belonging to *Colletotrichum cereale*. The material examined is listed below:

On *Andropogon nutans* (Kansas), *Festuca heterophylla* (France), *Festuca* sp. (Italy), *Panicum virgatum* (Louisiana), *P. Crus-galli* (Louisiana), *Sorghum saccharum* (Connecticut, New Jersey, France) *Sorghum* sp. (Alabama), and *Zea Mays* (New Jersey).

12. *Colletotrichum Bromi* Jennings

This species is known only from the type collection on *Bromus unioliodes* in Texas. It is merely a form of *Colletotrichum cereale* with small sporodochia, but otherwise typical.

13. *Colletotrichum lineola pachysperma* Ellis & Kellerm.

The fungus so named on *Chrysopogon nutans* from Kansas has conidia which measures 20 to 30 x 4 to 7μ. While its other characters would indicate that it is identical with the species described by Manns, the extreme size of the conidia will appeal to some as entitling it to the dignity of at least a trinomial. However as the forms considered as identical in this paper have a range of conidial measurements of 18 to 26 x 3 to 6μ this one does not materially change these measurements. In case a separate name is desired for the large-spored form, Roumeguere's *Vermicularia Lolii* appears to be the earliest published name for such a fungus. As the present name merely appeared on exsiccati labels, it cannot be considered as properly published.

14. *Colletotrichum cereale* Manns

Material under this name distributed by the Ohio Experiment Station has been examined on all the hosts mentioned at the time of original publication, except *Hordeum vulgare* and *Triticum spelta*. In addition similar specimens on *Arrhenantherum elatinus* and *Agrostis alba* have been examined. All agree with each other in their characters and show no points of difference from the material which has been discussed in the preceding pages.

All of these forms, which occur either on living or dead grasses, agree in habit and in the size and form of both conidia and setae, the measurements with few exceptions falling within a reasonable range of variation for a species which is so widespread both geographically and in its hosts. It would appear then that we are dealing with a single wide-spread species, of which possibly a large-spored form should be recognized. Were material of other grass-inhabiting species of Vermicularia and Colletotrichum at hand for comparison it is not impossible that some of these would be added to this already long list of names which have been applied to the species in question.

The synonomy and a recapitulation of the specimens examined, as well as other similar data is appended. The hosts are arranged by tribes. It is interesting to note that eight of the twelve tribes of the family are represented.

Colletotrichum graminicolum (Cesati) nom. nov.

Dicladium graminicolum Cesati, in Rabenh., Herb. Viv. Myc. *1677*. Flora **35**: 398. 1852.

Psilonia apalospora Berk. & Curt., in Ravenel, Fungi Carol. Exs. **3**: 83. 1855. (Hyponym)

Vermicularia culmigena Cooke, in Ravenel, Fungi, Amer. Exs. *531*. 1881. Not *V. culmigena* Desmaz., Ann. Sci. Nat. III, **3**: 363. 1845.

Steirochaete graminicola Sacc. Syll. Fung. **4**: 316. 1886.

Vermicularia sanguinea Ellis & Halst., Jour. Myc. **4**: 8. 1888.

Colletotrichum lineola pachyspora Ellis & Kellerm., in Ellis & Ev. N. Am. Fungi *2181*. 1889. (Hyponum)

Colletotrichum Bromi Jennings, Texas Agr. Expt. Sta. Bul. 9: 25. 1890. (Hyponym)

Vermicularia Lolii Roun., Rev. Myc. **13**: 131. 1891.

Colletotrichum sanguineum Ell & Hals.; Ellis & Ev. N. Am. Fungi *3466*. 1896.

Vermicularia Holci Sydow, Hedwigia (Beibl.) **38**: 137. 1899.

Colletotrichum cereale Manns, Selby and Manns, Ohio Agr. Expt. Sta. Bul. 203–207. pls. 1–10. 1909.

Specimens examined (arranged by tribes of Gramineae)

On Maydeae:

Tripsacum dactyloides L., South Carolina (Ravenel.).

Zea Mays L., Connecticut (Rorer), New Jersey (Ellis), South Carolina (Ravenel), West Virginia (Nuttall); Italy (Cesati).

On Andropogoneae:

Andropogon Hallii Hack., Mississippi (Tracy).

Chrysopogon nutans (L.) Benth., Kansas (Bartholomew, Kellerman *927*, Kellerman and Swingle).

Sorghum saccharum L., New Jersey (Ellis), France (Roumeguere).

Sorghum sp. (Jerusalem corn), Alabama (Underwood).

Sorghum sp. (Kafir corn), Alabama (Lamson-Scribner *10*).

On Paniceae:

Anthaenantia rufa (Ell.) Schult, Florida (Curtis *142*).

Brachiaria digitarioides (Carpenter) Nash, (*Panicum Curtisii* Chap.), Louisiana (Langlois).

Cenchrus tribuloides L., Delaware, (Commons *2571*).

Echinochlos Crus-galli (L.) Beauv. (*Panicum Crus-galli* L.), Kansas, (Bartholomew), Louisiana (Langlois *841*), Mississippi (Tracy, White).

Panicum virgatum L., Louisiana (Langlois *324*).

Panicum sp. cult., Iowa (Halsted).

Syntherisma sanguinale (L.) Dulac (*Panicum sanguinale* L.), New Jersey (Ellis).

On Agrostideae:

Agrostis alba L., Ohio (Selby).

Calmagrostis Epigeos (L.) Roth, Germany (Sydow).

Phleum pratense L., Ohio (Selby)

On Aveneae:

Arrhenantherum elatinus (L.) Beauv., Ohio, (Selby).

Avena sativa L., New Jersey (Schwarze), Ohio (Selby).

Holcus lanatus L., Germany (Sydow).

On Festuceae:

Bromus secalinus L., Ohio (Selby).

Bromus uniolioides (Willd.) HBK., Texas (Jennings).

Dactylis glomerata L., Mississippi (Tracy), Ohio (Selby).

Festuca heterophylla Lam, France (Faurey).

Festuca sp., Italy (D. Saccardo).

Melica uniflora Retz., Germany (Sydow).

Poa pratense L., Ohio, (Selby).

On Hordeae:

Lolium perenne L., France (Foutrey).
Secale cereale L., Ohio (Van Meter).
Triticum vulgare L., Ohio (Selby).

On Bambuseae:

Arundinaria sp., Alabama (Earle).

DISTRIBUTION: Southern New England to Iowa and Texas; also in Western Europe.

Exsiccati:

As *Colletotrichum lineola* Corda.
Briosi & Cavara, Fungi Par. *374*, Ellis, N. Am. Fungi *816*, Ellis & Everh., Funghi Columb. *154*, Roum, Fungi Gall. *1777*, Roum. Fungi Sel. Exs. *7008*, D. Sacc. Myc. Ital *117*.

As *Colletotrichum lineola pachyspora* Ellis & Kellerm.
Ellis, N. Am. Fungi *2183*.

As *Colletotrichum sanguinea* Ellis & Halst.
Ellis & Everh., N. Am. Fungi *3466*.

As *Dicladium graminicolum* Corda.
Rabenh. Herb. Viv. Myc. *1677*.

As *Psilonia apalospora* Berk & Curt.
Ellis, N. Am. Fungi *54*, Ravenel, Fungi Carol. Exs. 3: *82*.

As *Vermicularia culmigena* Cooke.
Ellis, N. Am. Fungi *741*, Ravenel, Fungi Amer. *531*.

As *Vermicularia Holci* Sydow.
Sydow, Myc. March. *4846*.

As *Vermicularia Lolii* Roum.
Roum. Fungi Gall. *5775*.

As *Vermicularia Melicae* Fuckel.
Sydow, Myc. March. *2455*, *4848*.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 168

PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION

II. ORIGIN OF THE ALPINE FLORA

P. A. RYDBERG

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Phytogeographical notes on the Rocky Mountain region II. Origin of the alpine flora*

P. A. RYDBERG

When studying the flora of a certain region or district, one naturally asks himself the following questions: What is the origin of these plants? Where did they come from? How did they come there? Where else are they found? Why are they found there and not in adjacent territory? Why are they there and not in other similar regions? Why are other plants found in similar regions and not there? Many other similar questions might be asked and none of them could be satisfactorily answered. We can only make suggestions and surmises. Some answers may seem satisfactory to us now, as others may have seemed satisfactory to generations gone by; others may seem merely probable, and still others not even so. The alpine regions of the Rockies are merely small isolated spots, when the whole mountain range is considered. They can be compared with a number of small islands, now surrounded (so far as many of the species are concerned) by barriers insurmountable, more so even than islands in an ocean could ever be. It is far easier to tell what an alpine plant is (and I have already in a former paper tried to give a definition thereof) than to tell how it came there. If we had only endemic species to deal with, we should perhaps explain its existence by a spontaneous generation or as something originated from a related species, which exists or has existed in the subalpine region below. The belief in a spontaneous generation, at least so far as the higher plants or animals are concerned, is now generally discarded. The derivation from related species of the subalpine region is in many cases a satisfactory explanation of the existence of many endemic alpine species but not of all. But how shall we explain the existence of the same plant in the alpine regions of Colorado and the Alps in

* In this paper the sedges have been omitted, as they have not yet been worked up. Without an authentic determination of the species, it is risky to discuss such a critical genus as *Carex* in a phytogeographical paper.

Europe, as for instance *Potentilla nivea*, *Lloydia serotina* and *Viola biflora?* This question leads to other related ones. Has a species originated only once or can the same plant arise at the same time or at different times at two or more isolated localities? Are the individuals of *Potentilla nivea*, now growing in Colorado, in the Alps, in Scandinavia, in Greenland, etc., offsprings of the same parent *Potentilla nivea* living ages ago, or did the species originate independently at the different places? In the case of *Potentilla nivea*, I rather think that it is monotypic and has had a much more general distribution than it now has, for it is a common plant in the arctics. But this is not the case with *Viola biflora*, which is not an arctic plant. Until lately the only localities known in this country were in Colorado, but now it is known also from Alaska.

It is not, however, impossible that some so-called species have had a polytypic origin. *Primula farinosa* is a plant of the Alps, northern Europe, northeastern America, and apparently the same plant is found in south Chile to Terra del Fuego. In both cases, however, the plant itself or else the parent plant, from which it originated, must have had a much greater distribution than it now has. We know of many plants which in earlier periods have been distributed over much greater territory than they now are, as for instance *Ginkgo biloba* and *Taxodium distichum* were once found in Europe, while they now are restricted, the former to northeastern Asia and the latter to the southern United States.

It was stated before that many of the alpine plants of the Rockies are also arctic or subarctic, and as far as the Rockies are concerned the seeds could be carried by wind and animals from mountain top to mountain top, as the stretches are not so far, the mountain chain running north and south, but this would not be a satisfactory explanation in Europe and Asia where the principal chains run east and west and at a great distance from the arctic. Another explanation must therefore be given. The most plausible and most generally accepted theory concerning the origin of the alpine flora is the following. In the glacial periods, the regions in front of the ice-sheet became unfit for the woody vegetation and in fact for all plants except the arctic-alpine elements. The forest receded south in front of the advancing ice. The temperature in the mountain regions south thereof became lower and lower, the glaciers increased and extended downwards and the forests receded down the mountain sides. At last the foothills and even the plains of northern Europe, Asia and America received an alpine-arctic climate and bore mostly arctic vegetation. As the ice sheet receded, the climate became more temperate, the forest again took possession of the land and the arctic plants were partly driven towards the pole, partly up the mountains, until in our days they are confined to the arctic regions and the highest mountain tops, where they have become isolated. In America the glacial drifts did not reach as far south as Colorado, but evidently the temperature during the glacial epoch must have been low enough, so that the local glaciers of the Rockies may have covered most of the mountains, and the great plains and the foothills surrounding them undoubtedly had an arctic or subarctic climate at that time. Many of the arctic plants had originated before the glacial period and had spread over the two continents. Some of these still exist on both, others might have died out on one of the continents, but remain on the other. Some might become exterminated in the mountain regions while continuing their existence in the arctic regions, or vice versa. Some, after isolation, might have changed in the course of time and developed into new species. This is perhaps more common in the case of the alpine than of the arctic plants. The arctic-alpine plants may therefore be classified in the following categories.*

1. Circumpolar arctic-alpine or glacial plants, found in the arctic as well as in the mountain regions of both continents.

2. Eurasian arctic-alpine or glacial plants, found only in the mountains of the Old World and the arctic regions. Some of these may be:

(*a*) European arctic-alpine or glacial plants, with the center of distribution in the Alps;

(*b*) Asiatic arctic-alpine or glacial plants, with the center in the Altai.

3. American arctic-alpine or glacial plants, confined to the mountains of the New World and the arctic.

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* Here I do not include the alpine plants of tropical regions, which must be considered altogether by themselves.

4. Eurasian alpine plants, found in the mountains of the Old World, but not in the arctic regions. The principal subdivisions of this group are:

(*a*) Alpestrian, endemic plants of the European Alps, including the Pyrenees and the Caucasus;

(*b*) Altaic, north Asiatic alpine plants.

5. American endemic alpine plants. The principal regions of these are the following:

(*a*) Sierra Nevada, including the Cascade Mountains, which latter, however, contain an intermixture of some elements belonging to the next;

(*b*) Rocky Mountains, including the San Francisco Mountains and the other ranges of Arizona, New Mexico and northern Mexico;

(*c*) White Mountains. Most of the plants of this region belong to the arctic-alpine group, but endemic alpine plants are not wholly lacking, as for instance, *Potentilla Robbinsiana* and *Sieversia Peckii.*

6. Circumpolar arctic plants, not found in the mountains.

7. Eurasian arctic plants, which do not concern us at all.

8. American arctic plants.

9. Subarctic and

10. Subalpine plants, which encroach on the arctic and alpine regions.

CIRCUMPOLAR ARCTIC-ALPINE OR GLACIAL PLANTS

These species probably had originated before or during the glacial epochs. In some cases the origin probably was somewhere in the Old World, in others in the New World. Of course, we cannot know, but we may surmise. The region which contains the most numbers of certain groups of species may probably be the place where this group originated (*i. e.* the home of the parent species) and where the individual species sprang from. As for instance, there is a group of arctic-alpine species of *Potentilla* with ternate leaves white-wooly beneath. *Potentilla nivea* is the most generally distributed species of the group; it is also the first and best known. Where is the probable ancestral home of this species? The species is found in Europe, rather common in the Scandinavian mountains, but not so common in the Alps. It is the only species of the group there. It is, therefore, not probable that its ancestry came from that region. The group is represented in both North America and Asia by several species. The American species, except *P. nivea* and *P. uniflora*, are rather local, and are modified to adapt themselves to local conditions. Both *P. nivea* and *P. uniflora* as well as *P. villosa* (found in the northwestern corner of this continent) are found in Asia, together with several others of the group. *P. nivea* itself is common there in the mountains as well as in the arctic, while it has been collected only at a few places in the Rockies of Colorado. It is therefore probable that the group originated in Asia.

Let us now discuss the plants of this category. The following plants are common to the arctic regions of both continents, the Alps, and the Rockies as far south as Colorado. Most of these are also found in Asia. Those with a star are also found in the subalpine regions.

**Phleum alpinum*	*Salix reticulata*
**Trisetum subspicatum*	*Oxyria digyna*
**Deschampsia caespitosa*	**Bistorta vivipara*
Poa cenisia	*Silene acaulis*
**Poa alpina*	*Thalictrum alpinum*
Festuca supina	*Ranunculus pygmaeus*
**Festuca ovina*	*Draba fladnizensis*
**Festuca rubra*	*Muscaria adscendens*
Juncus triglumis	*Potentilla nivea*
Juncus castaneus	**Astragalus alpinus*
**Juncoides spicatum*	*Campanula uniflora*
Lloydia serotina	*Myosotis alpestris*

Some of these species extend into mountains situated so far south that they could not have been connected with the arctic regions even in the glacial times. The existence of these species there has to be explained in some other way. In most cases their seeds were probably carried by birds or other animals or by the wind. Included among such plants are the following:

Lloydia serotina, a typical arctic-alpine plant, is found not only in the arctic regions, the mountains of northern Europe and Asia, the Alps, the Rockies and the Sierra Nevada, but also in mountains farther south, as the Pyrenees, the Caucasus, the Himalayas, and, in America, in the San Francisco Mountains, Arizona. Like most bulbiferous plants, it does not readily propagate by seeds, but when these are formed, they may easily be distributed by the wind on account of their flatness.

Juncoides spicatum has about the same distribution except that it is not found in the Himalayan region. The seeds of this species must have been carried by birds as they are too heavy to be carried by wind.

Poa alpina extends south to the Sierra Nevada (Spain), the Appennines, and the Himalayas, and *Trisetum subspicatum* and *Phleum alpinum* extend in America south through the mountains of Mexico, Central and South America. As these grasses also are subalpine, their seeds have probably been distributed by animals.

The following two species are common to the arctic regions of both hemispheres, to the Rockies, and to the Asiatic mountains, but not found in the Alps: *Draba glacialis* and *Anemone parviflora*.

Saxifraga cernua and *Campanula uniflora* are circumpolar glacial plants, but do not reach the Alps. They are found in America as far south as Colorado and Utah. Either these plants are of American origin and have extended their range over northern Europe, or else they have perished in the Alps.

The same may be said about *Micranthes hieracifolia*, although it does not reach the southern Rockies.

Aster alpinus is a glacial plant found both in the Alps and the Altai, rare in the Rockies and lacking altogether in the Scandinavian mountains.

Some of the circumpolar glacial plants, although they are found on this continent, are found neither in the southern Rockies nor in Sierra Nevada, although they are found in both the Alps and the Altai. Such are:

Cerastium alpinum	*Chondrosea Aizoon*
Erigeron alpinum	*Micranthes nivalis*

The first two are, however, represented by related endemic species.

A few of these circumpolar plants are found in the Alps, but neither in the Altai nor in the southern Rockies, as for instance

Tofieldia palustris. This is found in Great Britain, Scandinavia, northern Russia, the Alps, the Pyrenees and the Ural. Notwithstanding the fact that it is less distinctly arctic-alpine than for instance *Lloydia serotina* and has been collected in the lowland as far south as Two Harbors, Minnesota, it has not been collected in the Rockies south of northern Montana.

ASIATIC ARCTIC-ALPINE OR GLACIAL PLANTS

Dasystephana glauca is a distinctly Asiatic glacial plant, but also found in western North America, coming down south as far as Montana.

AMERICAN ARCTIC-ALPINE OR GLACIAL PLANTS

A large number of the alpine plants of the Rockies are strictly American glacial plants, i. e., found both in the mountains and the arctic regions of this continent but not in the mountains of the Old World.

1. In many cases they are there represented by closely related plants. In such cases the history of the plant might be the following:

(*a*) That the parent plant had a circumpolar distribution before or during the earlier part of the glacial period and the two related species developed independently from it;

(*b*) That the Old World plant existed on both continents during the glacial epoch and became modified after isolation on this side; or

(*c*) That the American plant existed and became modified abroad.

Here I give a list of such plants and the nearest relatives in the Old World.

AMERICAN	EUROPEAN	ASIATIC
**Calamagrostis purpurascens*	*C. arundinacea*	
Salix glaucops	†*S. glauca*	
Salix chlorophylla	*S. phyllicifolia*	
**Alsinopsis propinqua*	*A. verna*	

* Those starred are also subalpine and subarctic.

† *Salix glauca* and *Rhodiola rosea* are also found in northeastern America, but not in the Rockies.

American	European	Asiatic
Alsinopsis quadrivalis	*A. verna*	
Alsinopsis Rossii	*A. verna*	
Anemone zephyra	*A. narcissiflora*	*A. narcissiflora*
Ranunculus affinis		*R. pedatifidus*
Smelowskia americana		*S. calycina*
Rhodiola integrifolia	†*R. rosea*	
Leptasea austromontana		*L. bronchialis*
**Potentilla quinquefolia*	*P. nivea*	*P. nivea*
Potentilla nipharga	*P. nivea*	*P. nivea*
Vaccinium oreophilum	*V. Myrtillus*	
Androsace carinata	*A. Chamaejasme*	*A. Chamaejasme*
Androsace albertina	*A. Chamaejasme*	*A. Chamaejasme*
**Swertia palustris*	*S. perennis*	*S. perennis*
Amarella monantha	*A. tenella*	*A. tenella*
Amarella plebeia	*A. Amarella*	*A. Amarella*
Dasystephana Romanzovii	*D. Froelichii*	*D. frigida*
Condrophylla americana	*C. prostrata*	*C. prostrata*
Polemonium pulcherrinum		*P. humile*
Erigeron simplex	*E. uniflorus*	*E. uniflorus*
Erigeron melanocephalus	*E. uniflorus*	*E. uniflorus*
Artemisia saxicola	*A. norvegica*	
Artemisia spithamaea		*A. borealis*

Many of the endemic American glacial plants—or rather alpine-arctic plants, for most of them undoubtedly originated after the glacial period—are evidently derived from existing circumpolar glacial plants. Such are:

American glacial	Circumpolar glacial
Deschampsia curtifolia	*D. caespitosa*
Poa arctica	*P. cenisia*
**Festuca saximontana*	*F. ovina*
Agropyron biflorum	*A. caninum*
Cerastium Behringianum	*C. alpinum*
Draba andina	*D. glacialis*
Draba oligosperma	*D. glacialis*

Some of these arctic-alpine plants had probably the same parents as some existing circumpolar-arctic plants. While one offspring has remained arctic, *i. e.* has not spread south during the glacial period or else has died out in the alpine regions, the other has become both alpine and arctic with a purely American distribution, or else the latter has developed from the former since glacial time. Such plants are:

NORTH AMERICAN ARCTIC-ALPINE	CIRCUMPOLAR ARCTIC
Chrysosplenium tetrandrum	*C. alternifolium*
Antennaria media	*A. alpina*
**Antennaria umbrinella*	*A. alpina*

A few strictly arctic plants have for some reason spread into the Rockies, their existence there being a little hard to explain. Among these may be mentioned *Phippsia algida*, which has been collected in one place in Colorado. It is otherwise not known out of the arctic. *Sagina nivalis* has been found in Colorado; otherwise only in the arctic regions of America and in the Scandinavian mountains.

The following are truly endemic American arctic-alpine plants without any close relatives as far as I know elsewhere:

Ranunculus hyperboreus	**Erigeron compositus* and its close relatives, viz.
Aragallus podocarpus	**Erigeron multifidus*
**Vaccinium caespitosum*	*Erigeron trifidus*

The following are probably derived from subarctic or subalpine species:

**Calamagrostis Langsdorfii*†	*C. canadensis*, American, subalpine and boreal.
**Alsine laeta*	*A. longipes*, American, subarctic, subalpine and boreal.
**Kalmia microphylla*	*K. glauca*, eastern American, subarctic and boreal.
**Senecio cymbalarioides*	*S. aureus*, eastern American, boreal.

† This is also found in subarctic Scandinavia.

AMERICAN ENDEMIC ALPINE PLANTS

More than one third of the alpine plants of the Rockies are endemic and if the subalpine element found just over the timberline, or occasionally higher up, is included, this proportion is increased to about half of all the species. Several of these are apparently derived from circumpolar glacial or arctic plants.

SOUTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
Deschampsia alpicola	*D. caespitosa*
Ranunculus Macauleyi	*R. nivalis*
Parrya platycarpa	*P. macrocarpa*
Leptasea chrysantha	*L. Hirculus*
Muscaria delicatula	*M. caespitosa*
Muscaria micropetala	*M. caespitosa*
Saxifraga debilis	*S. rivularis*
Saxifraga simulata	*S. cernua*
Potentilla modesta	*P. nivea* (perhaps through *P. quinquefolia*)

NORTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
Salix nivalis	*S. reticulata*
Draba lonchocarpa	*D. nivalis*
Muscaria monticola	*M. caespitosa*
Micranthes Rydbergii	*M. hieracifolia*
Micranthes crenatifolia	*M. nivalis*
Spathularia Vreelandii	*S. stellaris*
Phyllodoce empetriformis	*P. coerulea*
Phyllodoce glanduliflora	*P. coerulea*
Cassiope Mertensiana	*C. tetragona*

SOUTHERN AND NORTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
Micranthes rhomboidea	*M. nivalis*
Micranthes arnoglosa	*M. nivalis*
Taraxacum scopulorum	*T. arcticum*
Salix saximontana	*S. reticulata*

Others have no close relative on this continent, but may have the same origin as some Old World plants. A list of these is here given with the nearest relatives abroad.

Northern Rockies	European	Asiatic
Salix Dodgeana	*S. retusa*	
Alsine americana		*A. dichotoma*
Leptasea Van Bruntiae		*L. bronchialis*
Drymocallis pseudorupestris	*D. rupestris*	
Eritrichium elongatum	*E. nanum*	*E. villosum*

Southern Rockies	European	Asiatic
Condrophylla Fremontii		*C. humilis*
Anthropogon barbellatum	*A. ciliatum*	
Eritrichium argenteum	*E. nanum*	*E. villosum*

Still other species are probably derived from, or have the same origin as, American glacial or American arctic plants.

Southern Rockies	
Poa pudica	*P. arctica*, glacial
Festuca minutiflora	*F. brachyphylla*, glacial
Salix pseudolapponum	*S. glaucops*, glacial
Alsine polygonoides	*A. laeta*, glacial
Cerastium Earlei	*C. Behringianum*, glacial
Caltha rotundifolia	*C. biflora*, subarctic
Draba pectinata	*D. andina*, glacial
Rhodiola polygama	*R. integrifolia*, glacial
Polemonium delicatum	*P. pulcherrimum*, glacial
Castilleja Haydeni	*C. pallida*, arctic

Northern Rockies	
Agropyron andinum	*A. biflorum*, glacial
Agropyron latiglume	*A. biflorum*, glacial
Salix cascadensis	*S. arctica* or *S. anglorum*, arctic
Cerastium pulchellum	*C. Behringianum*, glacial
Caltha leptosepala	*C. biflora*, subarctic
Caltha cheledoni	*C. biflora*, subarctic
Phacelia Lyallii	*P. sericea*, glacial
Polemonium parviflorum	*P. pulcherrimum*, glacial
Erigeron pedatus	*E. multifidus*, glacial

NORTHERN AND SOUTHERN ROCKIES

Bistorta linearifolia	*B. bistortoides*, glacial
Acomastylis turbinata	*A. Rossii*, arctic
Acomastylis sericea	*A. Rossii*, arctic
Mertensia nivalis	*M. lanceolata*, glacial
Castilleja occidentalis	*C. pallida*, arctic

Many of the alpine plants of the Rockies have their nearest relatives among the subalpine or mountain plants of the region. Such are

NORTHERN ROCKIES

ALPINE	SUBALPINE
Potentilla perdissecta	*P. diversifolia*
Potentilla decurrens	*P. diversifolia*
Pseudocymopterus Tiedestromii	*P. montanus*
Bupleurum purpureum	*B. americanum* (related to *B. ranunculoides* of Europe)
Phacelia alpina	*P. heterophylla*

SOUTHERN ROCKIES

Avena Mortoniana	*A. americana*
Poa Pattersonii	*P. crocata*
Eriogonum xanthum	*E. flavum*
Aquilegia saximontana	*A. brevistyla*
Thlaspi coloradense	*T. glaucum* (also closely related to *T. alpestre* of Europe)
Thlaspi purpurascens	*T. glaucum* (also closely related to *T. alpestre* of Europe)
Cheirinia amoena	*C. Wheeleri*
Cheirinia nivalis	*C. Wheeleri*
Cheirinia radiata	*C. asperrima*
Aragallus foliolosus	*A. reflexus*
Primula angustifolia	*P. Broadheadae*
Phlox condensata	*P. caespitosa*
**Mertensia Bakeri* † **Mertensia lateriflora* **Mertensia Parryi* **Mertensia viridula*	*M. lanceolata*
Besseya alpina	*B. plantaginifolia*
Achillea subalpina	*A. lanulosa*

† Those marked with braces constitute groups of closely related species.

SOUTHERN AND NORTHERN ROCKIES

Poa Lettermannii	*P. crocata*
Poa rupicola	*P. crocata*
Anemone tetonensis	*A. globosa*
Drymocallis pumila	*D. glandulosa*
Solidago decumbens	*S. oreophila*
Solidago ciliosa	*S. scopulorum*

The following alpine plants have no close relatives and seem to have originated in the Rockies:

Agropyron Scribneri
**Claytonia megarrhiza*
Paronychia pulvinata
Ranunculus adoneus
Ranunculus stenolobus
Delphinium alpestre
Gormannia debilis
Telesonix Jamesii
Telesonix heucheriformis
Potentilla saximontana
Potentilla minutiflora
Potentilla tenerrima
Trifolium nanum
**Trifolium Parryi*
Trifolium montanense
Trifolium salictorum
Trifolium Brandegei
**Trifolium dasyphyllum*
**Trifolium lividum*
**Trifolium stenolobum*
Trifolium attenuatum
Trifolium bracteolatum
Angelica Grayi
Oreoxis alpina
Oreoxis Bakeri
Oreoxis humilis
Polemonium viscosum
Polemonium Grayanum
Polemonium confertum
Polemonium speciosum
Polemonium mellitum
Polemonium Brandegei
Douglasia nivalis
Douglasia montana
Tonestus pygmaeus
Tonestus Lyallii
Xylorrhiza coloradensis
Xylorrhiza Brandegei
Rydbergia grandiflora
Rydbergia Brandegei
Artemisia scopulorum
Artemisia Pattersonii
Artemisia Parryi
Senecio Holmii
Senecio taraxacoides
Senecio Soldanella
Senecio petrocallis
Senecio Porteri

AMERICAN ARCTIC PLANTS

Many plants which have their main distribution within the arctic regions of North America are also found in the northern

Rockies; only a few of these extend far enough south to reach the boundary of the United States. In other words, only a few of them reach Montana and still fewer northern Idaho.

Salix alexensis	*Artemisia Richardsoniana*
Salix arbusculoides	*Artemisia arctica*
Salix Barrattiana	**Achillea borealis*
Salix Drummondiana	**Achillea multiflora*
**Tofieldia coccinea*	**Senecio lugens*
Micranthes foliolosa	*Potentilla emarginata*
Erigeron grandiflorus	*Amarella arctophila*
Erigeron lanatus	*Amarella propinqua*
Erigeron unalaschensis	*Mertensia Drummondii*
Antennaria alpina	*Castilleja pallida*
Antennaria monocephala	

Some of these arctic plants have a circumpolar distribution, as the following:

Juncus biglumis	*Muscaria caespitosa*
Juncoides arcticum	*Micranthes nivalis*
Juncoides hyperboreum	*Cardamine bellidifolia*
Juncoides arcuatum	*Mairania alpina*
Androsace septentrionalis	*Cassiope tetragona*
Saxifraga rivularis	*Pedicularis lanata*
Draba nivalis	*Pedicularis Oederi*
Draba alpina	*Pedicularis flammea*

The following are Asiatic-American arctic plants extending into the Canadian Rockies:

Cheirinia Pallasii	*Potentilla villosa*
Potentilla uniflora	*Campanula lasiocarpa*

SUBALPINE PLANTS

Besides these, there are many of the subalpine plants which occasionally are found above timber line. If the sedges, which I have not yet recorded, are excepted, the list contains 80 such species. There is no need of giving the list in this connection. If I should discuss in a subsequent paper the subalpine region, such a list would there find its place.

* Mostly subarctic-subalpine.

The alpine plants of all classes in the Rocky Mountains number about 250 species. The subalpine plants, which sometimes are found in the alpine region, are if the sedges are added over 100 in number. Hence about 350 species of flowering plants, or between 6 and 7 per cent. of the Rocky Mountain species, are growing within the alpine region.

NEW YORK BOTANICAL GARDEN

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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SOME MIDWINTER ALGAE OF LONG ISLAND SOUND

By MARSHALL A. HOWE

NEW YORK
1914

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SOME MIDWINTER ALGAE OF LONG ISLAND SOUND

By MARSHALL A. HOWE

For reasons that are more or less obvious the marine algae of the coasts of New York and New England have received little attention from collectors during the coldest months of the year. Mr. F. S. Collins once published in Rhodora* a brief paper on "Seaweeds in Winter", with a specific allusion to his experiences "at a point on the shore of Long Island Sound" on an intensely cold first day of January. Professor Bradley Moore Davis has more recently in his important contributions to the "Biological Survey of the Waters of Woods Hole and Vicinity" (p. 474) given a list of fifty-four species of algae "known to be present in the cold-water sublittoral formation of the winter and spring" and he remarks that the water temperatures for this formation probably average under 35° F. for at least two and a half months. Exact dates are not given, but it seems to be implied that any one of the fifty-four may be found during the coldest weeks of the year. A chart illustrating the algal flora of Spindle Rocks at Woods Hole on December 30, 1904, includes eighteen species and another for March 17, 1905, shows ten species. In the detailed list of the species of the Woods Hole region there are remarks on the seasonal distribution of each, such as "summer," "summer, undoubtedly at other seasons," "summer, undoubtedly throughout the year," "at all seasons," etc. In a recent interesting paper† on "The Seasonal Life-Cycle of some Red Algae at Woods Hole" Professor I. F. Lewis outlines the life-history of several

* **2**: 130–132. 1900.

† Plant World **17**: 31–35. 1914.

common red seaweeds of that region, but makes no specific references to midwinter observations.

The present notes have been suggested by several small collections of marine algae made at and near Orient, New York, by Mr. Roy Latham during the month of February of the present year, a February, by the way, that ranks among the coldest ever recorded by the New York City station of the United States Weather Bureau. Most of the specimens were found washed ashore after heavy storms and may have been passing the winter in the deeper waters, but there seems to be nothing in the list to excite suspicions as to the actual local occurrence of the species found.

The four following species were found "near the shore of Gardiner's Bay" on February 7:

Scytosiphon lomentarius (Lyngb.) J. Ag. Plants 14–20 cm. long with well-developed gametangia.

Cystoclonium purpurascens (Huds.) Kütz. Plant (or fragment) about 10 cm. high and incipiently tetrasporic. *Cystoclonium* is annotated by Davis as a summer plant at Woods Hole.

Agardhiella tenera (Ag.) J. Ag. A battered and weather-worn fragment with immature or somewhat abnormally developed tetrasporangia. Occurring with undoubted *Cystoclonium purpurascens*, the specimen might possibly be suspected of representing a coarse denuded condition of that species, but the mode of branching and the larger cells of the inner cortex as well as the stouter habit indicate that it belongs with *Agardhiella tenera*. Lewis considers this a summer species at Woods Hole, but Davis remarks of it, "summer, undoubtedly at other seasons."

Ceramium rubrum (Huds.) Ag. Apparently sterile.

The species of the list immediately following were found on the shores of the Sound on February 14, just after a severe storm:

Ulva Lactuca L.

Desmarestia aculeata (L.) Lamour. The denuded autumn and winter condition.

Laminaria Agardhii Kjellm.

Laminaria digitata (L.) Lamour.

Chondrus crispus (L.) Stackh. Tetrasporic.

Gymnogongrus Torreyi (Ag.) J. Ag. This is probably only a peculiar flattened condition of *Ahnfeltia plicata*, as has been pointed out by Professor Setchell.* The flattening, however, as in Agardh's type specimens, is often pronounced in the upper parts of the plant, the longer transverse axis being sometimes twice as long as the shorter.

Ahnfeltia plicata (Huds.) Fr.

Sterrocolax decipiens Schmitz. Abundant on "*Gymnogongrus Torreyi*," which fact may be interpreted as strengthening the idea that *G. Torreyi* is only a form of *Ahnfeltia plicata*.

Cystoclonium purpurascens (Huds.) Kütz. Apparently sterile.

Rhodymenia palmata (L.) Grev. Large tetrasporic specimens attached to *Laminaria* stalks.

Polysiphonia elongata (Huds.) Harv. Apparently sterile. The specimens are in part fibrillose and in part represent the coarse denuded autumn and winter condition. Davis ascribes the species to "summer," but Farlow† recognizes its perennial habit.

Spermothamnium Turneri (Mert.) Aresch. Attached to the base of *Polysiphonia elongata*.

Callithamnion Baileyi Harv. With mature cystocarps.

The following were collected on February 25. Mr. Latham writes that the *Chaetomorpha*, the *Sargassum*, and the *Champia* were taken by cutting a hole "through fifteen inches of ice on the bay":

Chaetomorpha Linum (Müll.) Kütz.‡

Sphacelaria cirrhosa (Roth) Ag. Attached to *Ascophyllum* (?) and forming tufts 0.5–1.5 cm. high. Davis refers this to the summer species.

Desmarestia aculeata (L.) Lamour.

Sargassum Filipendula (Ag.) J. Ag. A plant nearly 5 dm. high,

* Rhodora 7: 136–138. 1905.

† Mar. Alg. N. E. 172. 1881.

‡ *Ch. Linum* has been referred to *Ch. aerea* (Dillw.) Kütz. as a form by F. S. Collins (Green Alg. N. Am. 325. 1909). The plant described by Dillwyn may be the *natural* type of the species, but that described by Müller more than thirty years earlier would appear to be the *historical* type, and, if one is to be considered a form of the other, the rules of botanical nomenclature as now almost universally interpreted and applied would seem to demand that Mr. Collins' procedure should be reversed and that *Ch. aerea* should be regarded a form of *Ch. Linum*.

somewhat darkened and with scarcely developed receptacles, but otherwise of about the normal habit.

Phyllophora membranifolia (Good. & Woodw.) J. Ag. Tetrasporic.

Champia parvula (Ag.) Harv. Plants 3–4 cm. high, apparently sterile. This species is ascribed to summer by Davis.

Delesseria sinuosa (Good. & Woodw.) Lamour. A battered tetrasporic plant.

Polysiphonia elongata (Huds.) Harv. Plants 10-15 cm. long, fibrillose, apparently sterile.

Melobesia Lejolisii Rosan. On leaves of *Zostera*.

Dermatolithon pustulatum (Lamour.) Fosl. On leaves of *Zostera*, with the preceding.

Mr. Latham sent in for determination several collections also that were made in the month of March and so are perhaps not properly to be referred to as "midwinter" algae, but two of these collections were so little later than the month of February that they are of some interest in this connection. The first of these March specimens were picked up on the "Sound shore" on March 5, but are believed to have washed in "with the great storm of March 1." Omitting the common Fucaceae and a few others already mentioned, those of March 5 were

Halothrix lumbricalis (Kütz.) Reinke. On *Zostera* leaf, fertile.

Punctaria latifolia Grev. Sterile.

Desmarestia viridis (Müll.) Lamour.

Chondrus crispus (L.) Stackh. Tetrasporic and cystocarpic.

Phyllophora membranifolia (Good. & Woodw.) J. Ag. Tetrasporic and cystocarpic plants. The "nemathecia" of this species are in structure very suggestive of *Actinococcus subcutaneus* (Lyngb.) Rosenv., parasitic on *Phyllophora Brodiaei*. In form, however, they are strikingly different from the subspherical thalli of *Actinococcus subcutaneus* and a microscopical examination seems to indicate that they are integral parts of the *Phyllophora* thallus rather than parasitic organisms. The recently established facts as to alternation of generations in the Florideae, together with the obvious structural resemblances just alluded to, suggest a further consideration of Reinke's idea*

* In Darbishire, On *Actinococcus* and *Phyllophora*. Ann. Bot. 13: 264. 1899.

that *Actinococcus subcutaneus* may really be "an asexual generation of *Phyllophora Brodiaei*, growing parasitically on the sexual generation." Darbishire (*loc. cit.*) succeeded in showing that the thallus of *Actinococcus subcutaneus* develops from a spore that enters the thallus of the male plant of *Phyllophora Brodiaei* through an antheridial ostiole, but he was not able to discover whence the spore came or whether it was a tetraspore or a carpospore.

Polysiphonia urceolata formosa (Suhr) J. Ag. Sterile.

Rhodomela subfusca (Woodw.) Ag. Tetrasporic.

Ceramium rubrum (Huds.) Ag. Tetrasporic.

Rhododermis Georgii (Batt.) Collins. Forming cushions on the margins of *Zostera* leaves, with sporangia.

Corallina officinalis L.

On March 7, *Pylaiella littoralis* (L.) Kjellm., *Polysiphonia nigrescens* (Dillw.) Grev., and *Epilithon membranaceum* (Esp.) Heyd. were added to the foregoing lists.

New York Botanical Garden.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 170

NOTES ON ROSACEAE—VII

By PER AXEL RYDBERG

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Notes on Rosaceae—VII*

PER AXEL RYDBERG

ALCHEMILLA

In the North American Flora this genus is taken in a narrow sense, *i. e.*, as Linnaeus originally understood it. The genus *Aphanes* L., which was merged in *Alchemilla* by Scopoli, differs not only in the habit, being leafy-stemmed annuals, instead of scapose perennials with rootstocks, but the stamens are usually solitary, rarely more numerous, and opposite to one or more of the sepals, instead of being 4 and alternate with the sepals. The disk in the throat of the hypanthium, so characteristic of the typical Alchemillas, is almost obsolete in *Aphanes*.

The so-called Alchemillas of America are perennials, some of them in habit not so unlike the Old World species; but in all the stamens are only 2 and inserted on the inside of the disk instead of the outside, and the anthers extrorse instead of introrse. For these the subgeneric name *Lachemilla* of Focke was adopted, except for one species of exceptional habit, which was made into a distinct genus *Zygalchemilla*.

All the species of true *Alchemilla* have their home in Europe. Only five of them are either adventive or naturalized on this side of the Atlantic and all are confined to the northeastern corner of North America.

Alchemilla alpina L. ranges in America from Greenland to the island of Miquelon and the White Mountains of New Hampshire.

* These notes, continued from Bull. Torrey Club 38: 367 (1911), are supplementary to the monograph in volume 22 of the North American Flora.

Alchemilla pratensis F. W. Smith and the three succeeding species are segregated from *A. vulgaris* L. *A. pratensis* has usually been known here under the name *A. vulgaris* and has become naturalized from Nova Scotia to Massachusetts.

Alchemilla Wichurae Buser has been collected only in East Greenland.

Alchemilla glomerulans Buser and *A. filicaulis* Buser range on this side of the Atlantic from Greenland to Labrador, and the latter has been collected also on Newfoundland.

APHANES

See remarks under *Alchemilla*. The true *Aphanes arvensis* L. has been collected in America in Nova Scotia, evidently there an introduced plant. The American plants, included in it or confused with it, have much smaller flowers, the hypanthium being only 1 mm. instead of nearly 2 mm. long. They were distinguished in the North American Flora as four species, differing in minor characters.

Aphanes australis Rydb. includes all specimens collected in the southeastern United States. It differs from those on the Pacific coast in the short ovate sepals, connivent in fruit. In the western species the sepals are lanceolate to ovate-lanceolate and ascending in fruit.

Aphanes macrosepala Rydb. differs in the elongated sepals, nearly as long as the densely pilose hypanthium.

Aphanes occidentalis (Nutt.) Rydb. and *A. cuneifolia* (Nutt.) Rydb. have short sepals and puberulent or glabrous hypanthium. They differ from each other in the form of the leaves.

LACHEMILLA

See remarks under *Alchemilla*.

Lachemilla orbiculata (R. & P.) Rydb. and *L. venusta* (Cham. & Schlecht.) Rydb. belong to a group in habit and leaf-form approaching the genus *Alchemilla*, but the plants are sarmentose. Both *Alchemilla orbiculata* R. & P. and *A. pectinata* HBK. have been recorded for Mexico and Central America. It is evident that the specimens labeled as either of the two constitute but one species. A closer examination of literature and specimens has revealed that the two supposed species are identical, and that *Lachemilla orbiculata* ranges from Central Mexico to Bolivia.

The rest of the North American species except *L. ocreata* resemble *Aphanes* more strongly in habit and leaves, but they are all perennials.

Lachemilla procumbens (Rose) Rydb. is perhaps the most common of the Mexican species. Specimens of it are usually labeled *Alchemilla sibbaldiaefolia* HBK. Humboldt, Bonpland & Kunth's figure* shows that the original *A. sibbaldiaefolia* has different hypanthium, inflorescence and leaves, the latter in fact less like those of *Sibbaldia procumbens* than those of *L. procumbens* are.

Lachemilla domingensis (Urb.) Rydb. was based wholly on the description of *Alchemilla domingensis* Urb., no specimens of any *Lachemilla* having been seen from the West Indies at that time. Long after the publication of that part of the North American Flora containing *Lachemilla*, the first specimens were seen, but both the place in the key and the description were found to be correct and nothing needs to be added.

The following species were proposed as new: *Lachemilla Schiedeana* Rydb., *L. Pringlei* Rydb., *L. orizabensis* Rydb., and *L. Bourgeaui* Rydb. The first two were based in part on *Alchemilla hirsuta campestris* Cham. & Schlecht., which was described from a mixture.

Lachemilla ocreata (Donn. Smith) Rydb. is a very peculiar plant, apparently leafless, the leaves being reduced to connate imbricate sheaths, cleft into linear divisions. It is closely related to the South American *Alchemilla nivalis*.

ZYGALCHEMILLA

This genus was based on *Alchemilla pinnata* R. & P., which has pinnate instead of palmately lobed leaves, as all the other species of the tribe have. This character, as well as the 3-nerved sepals and bractlets, constitutes the basis for the generic segregation. A rather interesting fact in its history may be recorded. Remy† described a supposed new species as *Alchemilla pinnata*, but finding that the name was preoccupied by *A. pinnata* R. & P.,

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* Nov. Gen. & Sp. **6**: *pl. 561*.

† Ann. Sci. Nat. Bot. III. **6**: 354. 1846.

he changed it to *A. achilleaefolia* Remy.* Remy's species was based on Dombey's plant from Peru, he overlooking the fact that this plant belonged to the original *A. pinnata* R. &. P. He, therefore, originally described the same plant under the same name, and consequently the second synonym was superfluous.

SANGUISORBA

In the North American Flora, the genus *Sanguisorba* was taken in its original narrower sense, *i. e.*, the perennial species with only 2–4 stamens, and 1 pistil with muricate papillose stigmas. Of this genus, four native North American and one introduced species, *S. officinalis* L., were recognized.

Sanguisorba canadensis L. is limited to the northeastern part of this continent. The plants referred to it from the northwest belong to the following two species.

Sanguisorba sitchensis C. A. Meyer [*S. latifolia* (Hook.) Coville] has white flowers. Piper in his Flora of Washington,† makes the following remark: "The red-flowered form of this species is referred by Howell to *S. officinalis* L. The white-flowered ordinary form was referred to *S. media* L. in Hooker's Flora." This statement is not correct. Hooker's *S. media* is described as having red flowers and is the same as *S. Menziesii* Rydb., described in the North American Flora. Howell's *S. officinalis* has, as stated, red flowers, but the filaments are but slightly exserted and filiform, not twice as long as the sepals nor dilated. It is the same as *S. microcephala* Presl.

POTERIDIUM

I believe that the genus *Poteridium* Spach should be reëstablished for the annual species of *Sanguisorba* with brush-like stigmas. The first species of this genus was originally described as *Poterium annuum* Nutt. in Hooker's Flora Boreali-Americana. Hooker adopted Nuttall's manuscript name, which the author had applied to the species growing in Arkansas and neighboring states, but the specimens treated in that flora belong to the Pacific coast species. Hooker's *Poterium annuum* is, therefore, a composite. The

* *L. c.* III. 8: 224. 1847.

† Contr. U. S. Nat. Herb. 11: 336. 1906.

question then arises, which of the two species should be called *Poteridium annuum*. As Nuttall himself afterwards in Torrey & Gray's Flora separated the two, and applied *Poterium annuum* to the eastern plant and *P. occidentalis* to the western one, it is best to apply the names in that way.

POTERIUM

This genus resembles *Sanguisorba* in habit, but the stamens in the staminate flowers are numerous and declined; the pistils are usually 2, and the stigmas brush-like. Linnaeus originally had two species in this genus, of which the first, *P. Sanguisorba*, for several reasons must be regarded as the type. To use *Poterium* for the second species, *P. spinosum* L., as Focke has done,* is not correct. For that genus the name *Sarcopoterium* Spach should be used.

ACAENA

This genus has been taken in its narrower sense, excluding the genus *Ancistrum*.

Acaena agrimonioides HBK. I have seen no specimens agreeing with the original description of this species. All specimens seen and so named belong to *A. elongata*. Bitter, in Bibliotheca Botanica,† cited it as a synonym and on page 324 he stated that it is "to be regarded as synonymous with *A. elongata*," but nowhere does he give any reason for so doing. In the original diagnosis of *A. agrimonioides*, the leaflets are described as being 8–10 lines (*i. e.*, 16–20 mm.) long, and the lower gradually smaller. In all specimens of *A. elongata* I have seen from Mexico the leaflets are rarely 15 mm. long and the lower pairs scarcely smaller than the upper. Although *A. agrimonioides* is unknown to me and my description in the North American Flora was drawn from the original Latin diagnosis, I can but regard it as distinct from *A. elongata*.

Acaena elongata L. Hemsley in his Biologia Centrali-Americana‡ admitted four species of *Acaena* to Mexico, viz. *A. agrimonioides* HBK., *A. elongata* L., *A. lappacea* R. & P. and *A.*

* Engl. & Prantl, Nat. Pflanzenfam. 3^3: 45.

† 74: 28.

‡ 1: 378.

laevigata Vahl. Under *A. agrimonioides* HBK., he cited only Humboldt & Bonpland's specimens and hence held the same opinion of this species as I do.

In the North American Flora I have given my reasons for excluding *A. lappacea* and *A. laevigata* from the Mexican flora. There is no question regarding *A. laevigata* not being found there, neither is there in regard to *A. lappacea*, unless Bitter is correct in regarding it as a synonym of *A. elongata*. Against this speaks the fact that the typical *A. elongata* has not been found in Peru. In giving the distribution of *A. elongata*, Bitter gave "perhaps also in Peru," which shows that he had seen no specimens from that country. The typical *A. elongata* he described under the name *A. elongata gracilis* n. var. (an altogether unnecessary name), and this is limited by him to Mexico. It extends, however, through Central America to Colombia, but is not found as far south as Ecuador. Here it is represented by *A. elongata robusta* Bitter. If any form extends into Peru, it is this, which may be *A. lappacea*. My sincere opinion, however, is that *A. lappacea* was redescribed by Bitter under the name *A. torilicarpa* n. sp.

Acaena californica Bitter. The Californian species of *Acaena* has had a rather varied history. It was first treated by Hooker and Arnott in the Botany of Beechey's Voyage under the name *A. pinnatifida*, the authors supposing that it was the same as *A. pinnatifida* R. & P. of Peru. Torrey saw that it was not, but rather closer to *A. trifida* R. & P. and even listed it as such,* although it was not described under that name until twenty years later, in the Botany of California. For some years I have known that even this identification was erroneous, but have regarded it as the lost *Acaena tridactyla* Presl.† That author gives as the type locality "Mexico occidentale." As California at the time Haenke visited it was a part of Mexico, this interpretation does not seem out of place, and I still think it possible that it is not far from the truth. Bitter,‡ however, claimed that he had seen the type at Prague and identified it as the South American *A. trifida* R. & P. It is possible that Haenke, who also

* Pac. R. Rep. 4: 84. 1856.

† Epim. Bot. 201. 1849.

‡ Bibl. Bot. 74: 294.

collected in Chili and Peru, might have mislabeled the specimens. On the strength of this claim of Bitter's, I have reluctantly adopted his name *A. californica*. Bitter distinguishes not less than five varieties of this species. Anyone who knows the variability of the plant can see only individual variation in these varieties.

AGRIMONIA

Mr. Bicknell* in his paper on *Agrimonia* states:" Perhaps no one of our long-known plants has more effectually escaped a right understanding by botanists than the familiar Agrimony of the Eastern States, current in local floras and text-books as *Agrimonia Eupatoria* L." In fact, the genus as a whole was poorly understood here in America, before Mr. Bicknell took up the work on the same, and from the publication of his paper dates really our true conception of the species. It is strange, however, that this should have been the case, when Dr. Wallroth had presented a very good paper on the genus in 1842. It is true that most monographic work done in Europe on North American plants is rather poor and unreliable, and therefore we are liable to ignore such work done abroad. This might have been the reason why Wallroth's species have not been adopted. The writer took up most of Wallroth's names in the North American Flora. That Mr. Bicknell did not do so was unfortunate, as he will now not get the full credit for what his paper really was worth to us. The main reasons for his not taking up Wallroth's names were the following: (1) at that time the unfortunate Madison amendments to the Rochester Code were in force making older varietal names supplant specific names; (2) at that time the names proposed in Muhlenberg's Catalogue were generally regarded as properly published. In fact, most of them should be regarded as *nomina nuda*, for the adjectives added to these names evidently were not intended as descriptions, but as a part of the trivial or common name. If these two causes had not influenced Mr. Bicknell, I should not have had occasion to change his nomenclature except in one case, viz. *Agrimonia striata* Michx., which he had misunderstood. Even in this case, he was really not to blame. See below under that species.

* Bull. Torrey Club **23**: 508. 1896.

Agrimonia gryposepala Wallr. This has gone under the name of *A. Eupatoria* L. ever since Pursh's time or perhaps even since Walter's time. In general habit and in the size of the fruit it approaches more the European *A. Eupatoria* than any other of our North American species; but the structure of the fruit and the flowers are different. See the key. It was first distinguished by Muhlenberg, who gave it the name *A. Eupatoria hirsuta* in his Catalogue in 1813, but, as stated before, without proper description. It was subsequently published under Muhlenberg's name by Torrey in his Flora, in 1824. The first specific name, however, is that of Wallroth in 1842. His is also the first really good and extensive description. He was the first one to point out the peculiar sepals and characteristic arrangement of the bristles of the fruit, which distinguish it from any other of the species of the United States. It is therefore very appropriate that his specific name is now restored. The specimens from California, Arizona, New Mexico, and Mexico are usually somewhat different, but no constant characters have been found on which to base a separation.

Agrimonia macrocarpa (Focke) Rydb. This is the only North American species which approaches *A. gryposepala* in the structure of the sepals and of the fruit. It differs, however, in the elongated hypanthium and the more copious pubescence. Focke made it a variety of *A. parviflora*, to which it has little relationship. The only characters in which it approaches that species are the form (not the number) of the leaflets and the coarse pubescence. The structure of the fruit and the flower and the number of the leaflets are not at all the same. Its range is limited to Guatemala, from where the following specimens have been seen:

GUATEMALA: Coban, 1907, *von Tuerckheim 1377;* Dept. Huchuetenango, 1896, *Seler 2594.*

Agrimonia rostellata Wallr. Muhlenberg was also the first one to distinguish this species and gave it in his Catalogue the name *A. Eupatoria glabra*, but without a proper description. De Candolle mistook it for *A. parviflora* Ait., probably because it has the smallest flowers of all our North American species. It has also the smallest fruit, which is different from the rest in that it is more rounded at the base and less grooved. Mr. Bicknell adopted for this species the name *A. striata* Michx. See under that species, where the case is discussed in full.

Agrimonia microcarpa Wallroth. The first name for this species was *A. pumila* Muhl., printed in his Catalogue. The only thing said about this species beside the name is: "Small, Miss.," which means that the trivial name is small agrimony and that it grows in Mississippi. Now the only small agrimony growing in Mississippi is the present species and Mr. Bicknell evidently identified *Agrimonia pumila* Muhl. correctly. It had never been published under that name however, before Bicknell adopted it in his paper. There is no question that the species that Bicknell had in mind and that I now discuss is *A. pumila* Muhl. There is even more doubt that *A. microcarpa* Wallr. belongs to this plant. Wallroth cites three specimens: Pennsylvania (*Moser*), southern Georgia (*Beyrich*), and Jalapa (*Schiede*). As there is no indication of type, the first specimen should be regarded as such. I have seen no specimen of it from Pennsylvania, the nearest being from Maryland. In the former state it is represented by *A. platycarpa* Wallr. It is not likely that Wallroth should have confused the two species, as he is the author of both. Beyrich's plant undoubtedly belongs to *A. microcarpa* as here understood, but Schiede's plant from Jalapa, Mexico, belongs to *A. Pringlei.* The latter is glandular-granuliferous and must, therefore, be placed near *A. striata.* No one before Bicknell seems to have noticed the tuberous character of *A. microcarpa* and the other non-glandular species. This is not found in *A. Pringlei.*

Agrimonia platycarpa Wallr. This has not been recognized since Wallroth's time. It is closely related to *A. microcarpa.* In the latter the leaves are situated near the base of the stem, having either 3 leaflets of nearly the same size, or else also an additional much smaller pair below. In *A. platycarpa* the leaflets are 5 or 7 and the lower only slightly reduced. The fruit in *A. platycarpa* is broader than in *A. microcarpa,* usually broader than long, and with a more prominent flange or rim. Its range is more northern than that of *A. microcarpa.*

Agrimonia pubescens Wallr. This was first distinguished by Torrey & Gray under the name *Agrimonia Eupatoria mollis.* It was raised to specific rank by Britton,* following the Madison

* Bull. Torrey Club **19**: 221. 1894.

amendment and well knowing the publication of *A. pubescens* Wallr., which he gives as a synonym.

Agrimonia Bicknellii (Kearney) Rydb. This was well described by Mr. Bicknell* as a variety of *A. mollis*, but without a varietal name. This was supplied a year later by Mr. Kearney. It is true that the characters separating *A. pubescens* (= *A. mollis*) and this species are not absolute and that intermediate forms are not lacking. *A. pubescens* is at home in the central states west of the Alleghenies, but extends east thereof into Virginia and Georgia. The home of *A. Bicknellii* is the Atlantic coast, but it is found as far west as Pennsylvania and Tennessee. In the Mississippi valley only *A. pubescens* is found and on the Atlantic border only typical *A. Bicknellii*. The intermediate forms are found in the Alleghenian region, where the ranges of the two overlap. These two species are the nearest American representatives of the European *A. Eupatoria*, but have much smaller fruit. Especially is *A. Bicknellii* sometimes hard to distinguish from *A. Eupatoria* without the fruit. Two western specimens in the United States National Herbarium I have determined doubtfully as *A. Bicknellii*, viz. one collected at Fort Snelling, Minnesota, by Mearns, and the other at Naperville, Illinois, by Umbach. They may belong to *A. Eupatoria* L.

Agrimonia Eupatoria L. Britton and Bicknell believed that this species was not found at all in America. No specimen has been seen from the East, where the species is most likely to be found introduced. There are, however, two specimens, one in the National Herbarium and one in the herbarium of the Missouri Botanical Garden, which without any doubt belong to the species. Holzinger's specimen, especially, has the fruit so well developed that there is no question of the identity. The specimens are:

MINNESOTA: Winona, 1889, *Holzinger*.

WISCONSIN: Mirror Lake, 1903, *Eggert*.

Agrimonia striata Michx. This species has been badly misunderstood. Probably the real cause of this is that in Michaux's herbarium there are two specimens on the sheet of *A. striata*. The left-hand specimen represents the plant, here treated under that name, and the right-hand specimen is one of *A. rostellata*.

* Bull. Torrey Club **23**: 517. 1896.

One of the authors of Torrey & Gray's Flora, probably Dr. Gray, had seen this sheet, for they cite *A. striata* Michx. and appendage an exclamation point (!) after the same. They gave this as a synonym of their *A. Eupatoria parviflora*, which was based on *A. parviflora* DC., the same as *A. rostellata* Wallr. They also cite under this a specimen collected by Dr. Pitcher. This specimen is in the Torrey herbarium and belongs also to *A. rostellata*. This shows that Torrey and Gray regarded *A. striata* Michx. the same as what we now call *A. rostellata*. It was, therefore, not strange that Mr. Bicknell followed them, especially as one of the specimens in Michaux's herbarium belonged to that species. He, therefore, proposed a new name, *A. Brittoniana*, for the plant represented by the left-hand specimen in Michaux's herbarium and here treated under the name *A. striata*. By the courtesy of the Gray Herbarium we have received a print of a photograph of the type of *A. striata*, and this shows that the left-hand specimen is to be regarded as the type, not only bearing the name *Agrimonia striata* Michx., but also the word Canada on the labels. This is also the only species of the two which agrees with the description: "*fructibus . . . sulcato-striatis*."

Agrimonia Pringlei Rydb. One specimen of this, as said before, was included in *A. microcarpa* by Wallroth. It is true that it resembles that species, *A. platycarpa*, and *A. rostellata* in habit and leaf-form, but not in pubescence nor in the roots. The leaves are glandular-granuliferous and more or less pubescent as they are in *A. striata*, and the roots are not tuberous-thickened. It is represented by the following specimens:

MEXICO, STATE OF VERA CRUZ: near Jalapa, 1903, *C. G. Pringle 11876;* Huatusco, 1841, *Liebmann 1637;* State of Vera Cruz, *Pringle 11830.*

Agrimonia parviflora Ait. This species has been the best understood of the North American species except *A. incisa*. It is true that in the beginning two additional names were given to it, *A. suaveolens* by Pursh, and *A. serrifolia* by Wallroth. The latter was probably led astray by De Candolle who had used the name *A. parviflora* for another species, viz. *A. rostellata*. Lately, Professor Urban* has proposed a new species, *A. polyphylla*. To me

* Symb. Ant. 7: 227. 1912.

this seems only a slender form of *A. parviflora*, grown under somewhat abnormal conditions. The specimens on which this new species were based extend the range of *A. parviflora* to Santo Domingo.

Agrimonia incisa T. & G. No new facts were added in regard to this species in the North American Flora.

ADENOSTOMA

This genus has often been included in the Dryadeae, Sanguisorbeae, or Cercocarpeae. It could not very well be included in either the Dryadeae or the Cercocarpeae, as the ovules and seeds are inserted in the distal end of the ovary. It was placed in Cercocarpeae on account of its solitary achenes, but there are several other genera with solitary achenes that could not be placed in that tribe. In the characters of the fruit and hypanthium, it agrees best with the Sanguisorbeae, but the ovary is covered with a cushion, under the margin of which the style is inserted on one side and doubly bent; the species are shrubs of a peculiar habit with small entire linear leaves. It is, therefore, best to regard the genus as representing a distinct tribe.

Adenostoma fasciculatum H. & A. This species is very variable, and it is hard to decide if the next species should be merged in it or not. The leaves are either short or long, but usually distinctly petioled. The branches are glabrous or minutely puberulent, and in such cases approach the next species. *Adenostoma fasciculatum densifolium* Eastw. is in my opinion only a mere form of this species with more crowded leaves and inflorescence.

Adenostoma brevifolium Nutt. It was with some reluctance that I took up Nuttall's view regarding this plant. Usually, however, Nuttall had good reasons for his segregates, even if Torrey and Gray reduced many of them. Whatever value this plant may have as a species, the form is usually well marked by its short obtuse, subsessile leaves, and pubescent branches. S. Watson regarded it a variety of *A. fasciculatum*, and described it as var. *obtusifolium*. C. K. Schneider reduces the latter to a mere form, but describes a new variety under the name var. *hirsuta*. Whatever Schneider might have had in mind when he made the reduction, the fact is that his var. *hirsuta* is the same as the original *A. brevifolia* of Nuttall.

Adenostoma sparsifolium Torrey. This was originally described under the form "*A. sparsifolia.*" The name *Adenostoma* is, however, neuter. The species may perhaps represent a distinct genus as the throat of the hypanthium lacks the fleshy glands, characteristic of the type species.

COLEOGYNE

This genus was included in Cercocarpeae by Focke in Engler and Prantl's Pflanzenfamilien, but evidently erroneously so. The tribe Cercocarpeae in that work was a very unnatural one, composed of five genera. *Purshia* and *Chamaebatia* evidently belong to Dryadeae, notwithstanding their solitary carpels. *Adenostoma* and *Coleogyne* represent distinct tribes, which leaves *Cercocarpus* alone in the tribe. In *Coleogyne* the ovule and seeds are inserted at the distal end of the ovary and pendent, in Dryadeae and Cercocarpeae at the proximal end and erect or ascending. Furthermore, the pistil and the stamens in *Coleogyne* are separated by a tube equalling the stamens. The filaments are adnate to the base on the outside of this tube. Whether this tube represents a prolonged hypanthium or a set of abortive and united filaments, is hard to tell. The fact is that no such structure is found anywhere else in Rosaceae, but something similar is found in Capparidaceae. The fruit itself, however, is an achene, and hence very unlike the capparidaceous fruits. Another character abnormal to the Rosaceae is the opposite leaves and branches. The only other rosaceous genus, that I can remember, having opposite leaves is *Rhodotypus*.* The latter is so closely related to *Kerria* and in other respects typical, that no doubt can be entertained regarding its belonging to the family. It is not so with *Coleogyne*. Its peculiar flowers, its peculiar habit, more resembling Rhamnaceae, and opposite leaves and branches, etc., give rise to the question, may it not properly represent a new family?

WALDSTEINIA

Waldsteinia Doniana Tratt. Fifteen years ago Dr. Small distinguished from *W. fragarioides* a new species which he published

* Since the above was written Captain John Donnell Smith has described (Bot. Gaz. 57: 420. 1914) another abnormal genus with opposite leaves, viz. *Guamatela*.

under the name *W. parviflora*, the main difference being the smaller flowers. In looking up the illustrations of *W. fragarioides*, I found two plates that evidently illustrate *W. parviflora* instead of *W. fragarioides*. These were *plate 1567* in the Botanical Magazine and *plate 408* in the Botanical Cabinet. I also found that Trattinick had based his *Waldsteinia Doniana* on the former of these plates, which name therefore should supersede the later *W. parviflora* Small.

Waldsteinia lobata (Baldw.) T. & G. This species must be very local, for in the herbaria I have seen specimens from scarcely half a dozen localities, all in the mountains of Georgia and North Carolina. The achenes in this species are but 1 or 2.

Waldsteinia idahoensis Piper. This, like its eastern relative, is very local; in fact, it has been collected only at the type station, but may have a wider distribution, that region having been rather little botanized. The achenes are usually 2.

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A REVISION OF THE GENUS VITTARIA J. E. SMITH

RALPH C. BENEDICT

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A revision of the genus Vittaria J. E. Smith

I. THE SPECIES OF THE SUBGENUS RADIOVITTARIA

(WITH PLATES 15–20 AND SEVEN TEXT FIGURES)

RALPH C. BENEDICT

In an earlier paper on the genera of the fern tribe Vittarieae* the writer endeavored to point out the natural generic and subgeneric groups of the tribe, to discuss as well some of the interesting morphological features, and to indicate also the probable relationships of the genera. The present paper deals with the species of one of the subgenera of *Vittaria* indicated in the earlier paper. Most of the work of which the results are presented here was done before the paper on the genera was published, but completion was delayed until the present. As indicated by the title of this article, it is intended to continue the study of the species of *Vittaria*, and it may be added, most of the necessary work has been accomplished.

The genus *Vittaria* as delimited in the writer's paper already cited includes all those species of the tribe Vittarieae which have a midvein with uniseriate lateral areolae along each side formed by the pinnate interlocking simple veinlets. (See FIGS. 1–3; also the illustrations of venation under each plate.) As it appears, this type of venation is practically unique among ferns, the only possible exceptions being two or three species in the genus *Polypodium* L., as used in a broad sense. From such species as these the species of *Vittaria* differ largely not only in general aspect,

* Bull. Torrey Club 38: 153–190. *pl. 2–8*. 1911.

but in more critical characters of the scales, texture, and tissues, and especially in the uniform arrangement of the sporangia in indeterminate lines along the outer portions of the veinlets. (See FIGS. 1–7, and the plates.)

The taxonomic revision of *Vittaria* presents unusual difficulties as compared with other ferns, owing to the fact that although there appear to be a fairly large number of valid species—about forty—the very simple venation pattern allows only a small range of variation in the more evident characters of gross outline and venation, so that these, the characters ordinarily used in differentiating fern species, are not available. Nearly all the species are grass-like in the outline of the leaves, and the problem is thus about the same as would be offered by a genus of grasses if no flowers and fruit were obtainable. In the case of some few species, the differences in size, outline or coloration of the leaves, or in the venation, are sufficiently marked to allow of specific determination, but in general it is necessary to study the plants microscopically and by sectioning the stems and leaves, to arrive at any understanding of the real specific characters. It has been found by this method of study that there are very considerable differences in the outline of the leaf petioles and blades as best shown in cross-section, in the arrangement of the vascular tissues in the stem and petioles, and in the kind of cortical tissue developed. The scales which cover the stems and leaf-bases, although of one pattern, often show well-marked differences in cell structure. There may also be important differences in the shape of the spores and paraphyses.

Some of the differences in these characters have been indicated by one writer or another during the last sixty years or so, but no one has used them consistently or accurately over any number of species. The last and only monographic treatment of the whole genus was that by Fée* who attempted to figure the scales, spores, and paraphyses, as well as the general appearance of the species he recognized. Unfortunately he seems to have been inaccurate. Müller† discovered differences in the scales which seemed to him to justify the description of several new species, but he appears unfortunately to have missed the really important

* Mém. Foug. 3: 1852.

† Bot. Zeit. 537. *pl. 13.* 1854.

features of scale differences and to have made several species from what should properly be included in only one. Mettenius* and Luerssen† described and figured accurately some of the important differential characters of leaf outline as seen in section, but neither writer covered many species. More recently Jeffrey‡ and Mrs. Britton and Miss Taylor§ have described and figured carefully the morphology of one or two species each. The present paper represents an attempt to describe and figure as thoroughly as necessary the differential characters of the seven species included in the subgenus *Radiovittaria*, as I have recently described it. As has been noted, these seven species are all American.

The work of which this paper, as also the earlier paper on the genera of the tribe Vittarieae, is a partial report, has been carried on intermittently during the last six years at the New York Botanical Garden. The present article was brought nearly to completion during a month's residence as research scholar during parts of November and December, 1911, also at the N. Y. Botanical Garden, and I am glad to acknowledge my indebtedness to Dr. N. L. Britton for the opportunities of study thus afforded. In general the material studied has been sufficiently cited in my earlier paper on the genera of the tribe, but important additional material has been received from the collections of Mr. W. R. Maxon in Panama, and I have also been greatly aided by Mr. Maxon's descriptions of the field conditions under which his material grew.

The present paper deals with less than one fifth of the total species of *Vittaria*, but in order that the problems of the characters and nomenclature may be clear at the start, a description of the genus and its synonymy are included and also a discussion of its division into subgenera.

VITTARIA J. E. Smith, Mem. Acad. Turin **5**: 413. *pl. 9.* 1793

(Type species *Pteris lineata* L.)

Haplopteris Presl, Tent. Pterid. 141. 1836.

* Fil. Hort. Bot. Lips. 25–27. *pl. 27, f. 21, 22.* 1856.

† Schenk & Luerssen, Mittheil. Bot. 1: 57. *pl. 11–19.* 1871.

‡ Phil. Trans. Roy. Soc. London **195 B**: 119–146. *pls. 1–6.* 11 Je 1902.

§ Mem. Torrey Club **8**: 185–211. *pl. 28.* 1902.

(Type species *Pteris scolopendrina* Bory)

Taeniopteris Hooker, Gen. Fil. *pl. 76 B.* 1842.

[Type species *Vittaria Forbsei* Fée = *V. scolopendrina* (Bory) Thwaites]

Taeniopsis J. Smith, Jour. Bot. 4: 67. 1841.

(Type species *V. lineata* [L.] J. E. Smith)

Ferns usually of epiphytic habit and of comparatively small dimensions, of herbaceous texture and entirely without sclerenchymatous tissue; stem slender, creeping, clothed with clathrate scales, the vascular tissue in the form of a tube (siphonostele) or a simple net (dictyostele); the phyllotaxy distichous or radial; leaves usually few, linear to linear-elliptic, usually grass-like in outline, the epidermis with scattered linear cystoliths, the leaf-trace single or double, the venation consisting of a midvein with pinnate branches which anastomose anteriorly to form a row of simple areolae along each side of the midvein; sporangia in two indeterminate submarginal or sometimes practically marginal lines along two continuous receptacles formed by the outer portions of the veinlets, the receptacle usually in a groove often of considerable depth and sometimes with the edges produced so as to serve as an indusium; a true indusium wanting; spores diplanate or triplanate; paraphyses usually present, consisting of large reddish or yellowish cells borne on simple or branching pedicels.

The generic name *Vittaria* is fortunately well established. It was based originally on a single species, *Pteris lineata* L., so that there is no difficulty as to its typification, notwithstanding the fact that by several writers another species has been recognized as type. *Pteris lineata* has even been made the type of another genus, *Taeniopsis* J. Smith. Smith based his division of *Vittaria* on the position of the sporangial line, including in *Euvittaria* the species of the type of *V. elongata* Sw., in which the fruiting line is practically marginal, the leaf margin being double and including the sporangia between the two lips. This type, however, as Luerssen has shown, is not generically different from that of *V. lineata*, in which the lines of sporangia are clearly submarginal and dorsal. The extremes of the two types are connected by all possible intermediate forms among the various species.

Haplopteris Presl was based on the largest species in the genus, *V. scolopendrina* (Bory) Thwaites. Superficially this is very different from species like *V. lineata* and *V. sikkimensis* Kuhn, but in its essential characters it does not appear to have even subgeneric differences from *Euvittaria*. *Taeniopteris* Hooker is a straight synonym of *Haplopteris*, as its original species seems to be identical with *V. scolopendrina*.

The only other possible nomenclatorial difficulty in connection with *Vittaria* concerns the name *Oetosis* Necker,* published in 1790. Of course if this name were to be found valid, its seniority of three years would give it precedence of *Vittaria*. It is, however, like most of Necker's names, quite without definite typification, and if recognized as originally described, would comprise in its six Linnaean species five widely separated genera. I make this statement with entire assurance notwithstanding the fact that Dr. E. L. Greene has concluded from the same evidence that Necker intended *Oetosis* to include only one Linnaean species, *Pteris lineata*, the type of *Vittaria*. Since Christensen also is not certain that *Oetosis* might not properly replace *Vittaria*, it may be worth while to give in some detail the evidence which needs to be considered, particularly as it bears on questions relating to other Neckerian names.

To begin with, it may be stated that Dr. Greene's error springs from two incorrect premises. These are: first, that Necker intended his description of *Oetosis* to be applied only to one Linnaean species of *Pteris*, instead of to several; and second, that when Necker referred to Linnaean plants, he had reference to the first edition of Species Plantarum and to no other work of Linnaeus. I am indebted to Dr. J. H. Barnhart for the discovery of both these inadvertencies.

In correcting the second of these mistakes, it is almost sufficient to suggest that it is scarcely probable that Necker would have used such an out-of-date work as the first edition of the Species Plantarum when there were two later editions of the same book, as well as several later editions of Linnaeus's Systema Naturae, the latest of these having appeared in 1784, six years before Necker's Elementa Botanica appeared. The case is about the same as at present with the various editions of the floras of the

* Elementa Botanica 3: 318. 1790.

United States. Only the latest editions are of any general interest or use.

For incontrovertible evidence, however, that Necker used later texts than the 1753 Species Plantarum, I am able to cite two distinct references which I owe to Dr. P. A. Rydberg and which definitely identify the Linnaean work to which Necker is referring as the fourteenth edition of the Systema Naturae, the work of John Murray and not of Linnaeus. These references are Necker, Elementa Botanica **2**: 94, and **3**: 12.

The other of Dr. Greene's misconceptions has to do with the wording of Necker's original description of *Oetosis*, which is as follows:

1726. CHAR. DIAGN. *Lineae*, parallelae, ad periphaeriam frondium, in aversa pagina.
Frondes simplices.
CHAR. PEC. *Fructific.* lineae parallelae, ad periphaeriam in aversa pagina frondium sitae.
Globuli, coacervati; singuli, annulo elastico cinguntur.
Besimina in globulis inclusa, exigua, fertilia.
Individua neutra in hac specie, stipitata.
Frondes simplices. Quaed. Pterid. *Linn.*

In the first place, it seems to me *a priori* improbable that Necker could have intended this description to apply to only a single Linnaean species of *Pteris*. "Quaed." is of uncertain number as far as its form is concerned, but I believe in this case it is certainly plural. A general examination of Necker's text will show that the generic names used are either Linnaean names or else they are new; that is, apparently he has either retained the Linnaean genera exactly, or he has divided them, retaining the old name for part of the species and proposing a new name for the others. Often in such a case, it is evident that Necker's new genus corresponds exactly to some species-group recognized by Linnaeus. The present case furnishes a good illustration of this point.

The genus *Pteris* as delimited in the first edition of Species Plantarum (and later texts) is divided into three groups as follows:

"Frondibus simplicissimis

"Frondibus simpliciter pinnatis

"Frondibus sub-compositae"

Necker retains *Pteris* to include, as he writes, "*frondes compositae.*" In *Oetosis*, however, the leaves are "simplices," and it is reasonable to suppose that he meant to include under this name all the Linnaean species of *Pteris* with simple leaves. In the 1753 Species Plantarum there are four of these, but by 1767 two others had been added, and this is also the number in Murray's edition of the Systema Naturae of 1784. This fact seems to have been overlooked by Dr. Greene, but it was noted by Kuntze, who in attempting to validate *Oetosis*, selected as type of the genus the first species named in the later Linnaean works, i. e. *Pteris piloselloides* L., which, however, was not among the four known to Linnaeus in 1753. Thi, would identify the genus with a group of the tribe Polypodieae, now known either as *Drymoglossum* Presl, or perhaps more properly as *Pteropsis* Desvaux.

It is probably unnecessary to pursue further the *ignis fatuus* of a type for *Oetosis*, but it may be stated with certainty as additional confirmation of the invalidity of this name that Necker's description does not, as was Dr. Greene's main contention, fit *Pteris lineata* better than any other of the simple *Pterides* known to Linnaeus. The specific phrase which he cited as diagnostic, "lineae parallelae," may be applied as well to the *Pteris piloselloides* of Linnaeus, but it is scarcely probable that Necker had any thought of distinguishing generically between one species which has sporangial lines exactly parallel as in *Vittaria lineata*, and another in which the lines diverge from the parallel one or two degrees as in Linnaeus's *Pteris lanceolata* and others.

Subgenus RADIOVITTARIA Benedict, Bull. Torrey Club 38: 166. 191

Stem radial, phyllotaxy polystichous, leaf-trace always single, stem and petioles brown, owing to the highly developed collenchyma. Spores diplanate, paraphyses with cupuliform terminal cells.

The radial stem structure and leaf arrangement as well as the specialized collenchyma (see FIG. 6) serve to separate the species included from the other species of the genus, which also show a much wider range of characters.

In the key which follows, the species are arranged as nearly as possible according to natural relationships. *V. minima*, the simplest of the species treated, belongs at the bottom of the series, and is probably like the primitive form from which the others have been derived. The remaining six species fall naturally into two groups as indicated.

In connection with the species-descriptions, complete citations of the specimens examined are given. The letters following the individual citations refer to the herbarium in which the specimen is located. "U" represents the Underwood Fern Herbarium of the New York Botanical Garden; "N" the National Herbarium at Washington; "E" the Eaton Herbarium at Yale; "C" the Herbarium of the Botanisk Museum of Copenhagen.

Leaves 3–6 mm. long.	1. *V. minima.*
Leaves more than 6 mm. long.	
Petioles 2-angled from near the base, lamina with a ventral ridge along the midvein	
Sporangial line 0.5–1 mm. from the margin, lamina linear.	
Lamina less than 1 cm. broad (4–7 mm.), the areolae longitudinal.	2. *V. Gardneriana.*
Lamina usually more than 1 cm. broad, the areolae oblique.	3. *V. remota.*
Sporangial line 2–3 mm. from the margin, lamina elliptic to lanceolate.	4. *V. latifolia.*
Petioles terete or oval in section except near the top, lamina without a ventral ridge.	
Scales unicostate (rarely 2–3 costate), sporangia in two narrow deep grooves about 0.5 mm. from the margin.	5. *V. stipitata.*
Scales always pluricostate, sporangia in a shallow groove 1–1.5 mm. from the margin.	
Lamina 4–10 mm. broad, the margins parallel, scales of the petiole longer and narrower than those of the stem.	6. *V. Ruiziana.*
Lamina 8–14 mm. broad, narrowed both ways from the middle, scales all alike, with heavy costae.	7. *V. Williamsii.*

1. VITTARIA MIMINA (Baker) Benedict, Bull. Torrey Club **38**: 164. 5 My 191

Antrophyum minimum Baker, Ann. Bot. **5**: 448. 1841.

Hecistopteris minima Benedict, Bull. Torrey Club **34**: 457. 19 O 1907.

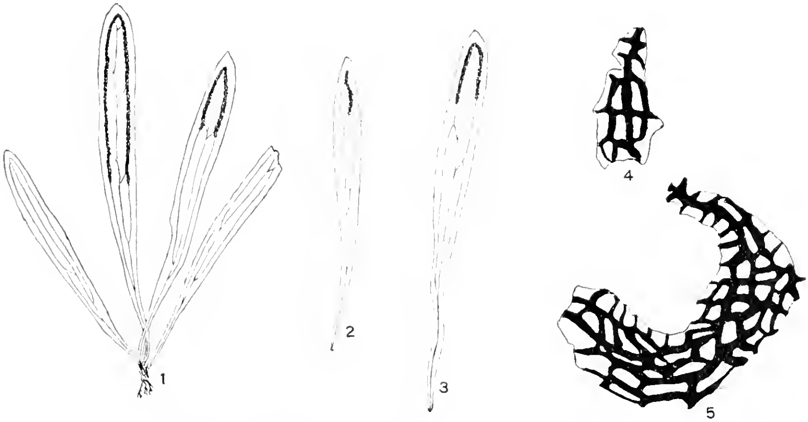
Antrophyum Werckleanum Christ, Bull. Herb. Boiss. II. **5**: 11. 1905.

Hecistopteris Werckleana Christ, Bull. Herb. Boiss. II. **7**: 265. 1907.

Stem slender, 4–5 cm. long, the scales small, often contorted, 4–6 cells wide at the base, the costae rather heavy; leaves few, spreading, 3–6 cm. long, the petiole brownish, the lamina oblong or lanceolate, broadest about the middle, 4–7 mm. broad, long-acute or sometimes blunter and forked, the margins plane, the leaf-trace single, dividing to form 2–8 veinlets, the areolae parallel to the midvein; sporangial line nearly straight, 1.5–2 mm. from the margin, superficial, the paraphyses as in the other species of the subgenus. (TEXT FIGS. 1–5.)

TYPE from COSTA RICA: *Endres, 1869*, 5,000 ft. altitude.

SPECIMENS EXAMINED. COSTA RICA: (without definite localities), *Endres*, type; *Werklé*, 1903 (= *Hecistopteris Werckleana* Christ).



FIGS. 1–5. *Vittaria minima* (Baker) Benedict. Figures 1–3 show general habit of species, soriation, and venation. (All natural size.) Figures 4 and 5 illustrate a small and a large scale from the stem (enlarged about 60 times). All the drawings are from material of the original collection of Endres.

To *Vittaria minima* may be accorded the distinction of being the simplest species in the genus, and it is also one of the few species of *Vittaria* which can be adequately differentiated by a knowledge of its more evident characters of size and venation. There is no other American species with which it need be confused, and the smallest Old World species, *V. sikkimensis* Kuhn, has a different outline and texture and bears the sporangia in distinct grooves, to say nothing of other marked differences. The material illustrated (*Endres*) does not show the narrowed apices believed to be characteristic of the species, but the blunting appeared to be abnormal. In the Wercklé material, of which two plants and a photograph of a series of plants were seen, the narrowed almost acuminate tip was an evident character.

Vittaria minima, in spite of its obvious differences from the other species, falls naturally into the genus and into the subgenus *Radiovittaria*. There was so little material that no attempt was made to section the stem or petiole, but the brown coloration of the petiole probably indicates the presence of the kind of collenchyma found in this subgenus. The fact that the spores and paraphyses are indistinguishable throughout the seven species is further evidence of close relationship.

It is also worthy of note that there appear to be good grounds for believing that *V. minima* is a real connecting species between *Vittaria* and *Hecistopteris* J. Smith, as has already been indicated in the synonymy. The occurrence of identically the same type of paraphysis and spore in *Hecistopteris*, as well as the suggestively similar leaves sometimes developed in this genus, lead to the suspicion that *Hecistopteris* is probably more a genus of taxonomic convenience than one of generically different evolution.

2. VITTARIA GARDNERIANA Fée, Mém. Foug. **3**: 15. *pl. 3.* 1851

Vittaria Karsteniana Mett. Ann. Sci. Nat. Bot. V. **2**: 207. 1864. (Type from Colombia.)

Vittaria gracilis Kuhn; in Moritz, Linnaea **36**: 67. 1869. (Type from Colombia.)

Rhizome erect, unbranched, 1.5–2.5 cm. long, with the persistent petiole bases about 0.05 cm. thick (about 2 mm. thick in section), radially symmetrical, the scales brown, iridescent, soft, lanceolate, 5–8 cells wide at the base. Leaves several, erect or spreading, 20–40 cm. long, usually very thin, the petiole solid, about 1 mm. thick (less when dry), terete at first, but soon becoming flattened and angled laterally, dull brown or greenish brown, or becoming polished, 1–3 cm. long, the lamina broadest (3.5–7 mm.) near or just above the middle, narrowed very gradually above and below, with or without a median brown stripe extending a few centimeters along the surface from the petiole, either thin, and with all the veins prominent, or thicker, and with the veins immersed, but with a strong convexity over the midrib along the ventral surface, the margins acute, plane, the leaf-trace single, thick-reniform in section, branching in the very base of the petiole to form the midrib and secondary veinlets, the veinlets intersecting, 1.5 cm. apart along the margin, the marginal portions forming a nearly straight line, the areolae with their axes parallel to the midrib; soral line nearly straight, about 0.5 mm. from the margin, sunken in a shallow open groove, the paraphyses numerous, pyriform, becoming collapsed and wrinkled, the spores diplanate. (PLATE 15.)

TYPE from BRAZIL: Organ Mts., *Gardner 147*, 1837.

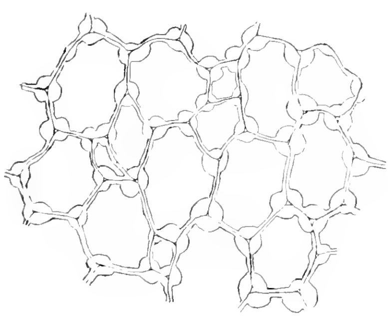
SPECIMENS EXAMINED. BRAZIL: Organ Mts., *Gardner 147* (scraps of type, U); *Glazion 3553* (C). COLOMBIA: Santa Marta, 6000 ft., *H. H. Smith 1112 in part* (several plants, U, N); Bogota, *Lindig 176, vide V. Karsteniana* (U). VENEZUELA: Tovar, *Fendler 259 b* (U, E). ECUADOR: "crescit in silv. trop. et suband.," *Sodiro* (U); *Jameson 1116* (E); Quitensian Andes, *J. P. Couthouy 25*, 1885 (E). BRITISH GUIANA: Mt. Roraima, *Mt. Roraima Expedition 212*, 12 Nov. 1884 (N).

Fée cites in addition: MEXICO, *Goudot, Pl. Mex.* and Colombia, *Moritz 1226*. For *V. Karsteniana* Mettenius cites specimens as follows, all from COLOMBIA: San Pedro, prov. Ocaña, *Schlim 318;* Bogota, altit. 2,800 m., La Peña, altit. 2,900 m., *Lindig 176;* Quindio, altit. 3,000 m., *Triana;* Tolima, *Goudot.* The type of *V. gracilis* is from COLOMBIA: Tovar, *Moritz 464*.

Vittaria Gardneriana and *V. remota* are species of similar habit and appearance and are undoubtedly closely related to each other. Broad leaves of *V. Gardneriana* are not easy to distinguish from narrow leaves of *V. remota*, but in general, taking whole plants, the differences in breadth of leaves, etc., appear sufficiently constant to warrant the recognition of two species, especially as these differences seem to accompany partly separated geographic ranges. The material from Central America, where both species occur, offers no special difficulties in differentiation, even in the herbarium, and it is not unlikely that field study will discover additional differences. *V. Bommeri* Christ, referred to later in the present article as a species of uncertain identity, is apparently of the same general size and shape as *V. Gardneriana*.

3. VITTARIA REMOTA Fée, Mém. Foug. 7: 26. *pl.* 20, *f.* 1. 1857

Rhizomes erect, often associated in clumps of 5 or 6, 0.5–2 cm. long, about 2 mm. thick in section, radially symmetrical, the scales lanceolate, brown, 7–11-costate at the base, the median costae considerably thickened; leaves 2–10, cespitose, 15–42 cm. long, the petioles purplish-brown, sparsely verrucose, solid, 1–5 cm. long, about 2 mm. thick, nearly terete at first but soon flattened and angled, the laminae linear-lanceolate, broadest (6–18 mm.), about the middle, somewhat acuminate, below very gradually narrowed and marked with a dark brown stripe both ventrally and dorsally, the margin plane, thin and sharp, the leaf-trace single, branching in the base of the petiole, the midrib marked ventrally by a distinct angled ridge, whitish on the dorsal surface, veinlets 4–9 per cm.,



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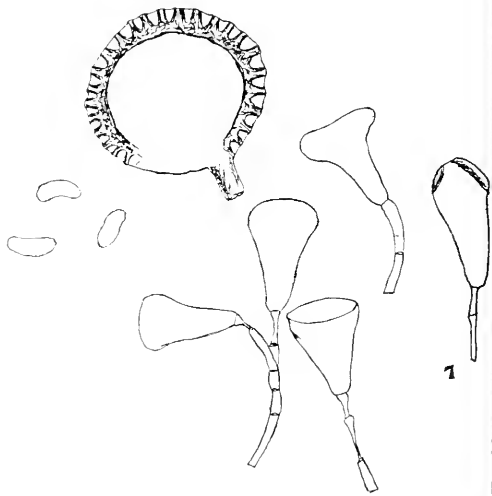

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FIGS. 6 and 7. *Vittaria remota* Fée. FIG. 6. Well-developed collenchyma from the stem. (Material collected by *P. Wilson 81*, Porto Rico. Enlarged about 300 times.) FIG. 7. Showing spores, paraphyses, and a sporangium. (Enlarged about 60 times.) Two of the paraphyses, the lower two, are shown partly collapsed, their usual condition when dry. (From material collected by *R. S. Williams 889*, Panama.)

intersecting 0.5–1.5 cm. apart along the margin, the areolae linear, with the long axes usually divergent from the midrib; soral lines slightly crenate, 0.5–1 mm. from the margin, in an open shallow groove. (PLATE 16 and TEXT FIGS. 6, 7.)

TYPE from COLOMBIA: province of Ocaña, altit. 2,400 m., on trees in forest, *L. Schlim 611*, 1846–52.

SPECIMENS EXAMINED. VENEZUELA: Tovar, *Moritz 143 in part* (U); Tovar, altit. 2,300 m., *Fendler 260* (U, E). PANAMA: Cana, 2,000 m., *R. S. Williams 889* (U). COSTA RICA: La Palma, altit. 1,450–1,550 m., *Maxon 397* (U, N); La Palma, *C. Brade*, 26 Mr 1908 (N); *L. C. Wercklé*, 1901–05 (U, N). JAMAICA: numerous collections by *Jenman* (U), *Underwood* (U, N); *Maxon* (U, N), *Harris* (U), and *Clute* (U, N). PORTO RICO: Sierra de Luquillo, *P. Wilson 81* (U, N); *Sintenis 1139* (U, N); Sierra de Naguabo, *Sintenis 5451* (U, N); El Yunque Mts., *Everman 674* (N); *Blauner 307* (U).

Vittaria remota seems to be the commonest West Indian species of this subgenus, at least as far as representation in herbaria is concerned. It is most easily distinguishable from the preceding species, as has been noted, by the greater breadth of the leaves. In scales and rhizome, it is generally similar.

4. **Vittaria latifolia** sp. nov.

Rhizome erect, unbranched, 1–2 cm. long, with the persistent petiole bases and roots about 5 mm. thick, 2–3 mm. thick in section, radially symmetrical, the leaves and roots arising from all sides, the scales ciliate, dull brown, very soft, lanceolate, 7–10-costate at the base, the costae uniformly slender; leaves 3–6, erect or spreading, 12–22 cm. long, the petioles solid, about 2 mm. thick, flattened and laterally angled except at the very base, dull brown or greenish, 1–4 cm. long, the scales like those of the rhizome but smaller, the lamina herbaceous, thin, narrowly lanceolate, broadest (1.5–2.2 cm.) near, usually somewhat above, the middle, acute with a blunt apex, narrowed very gradually below into the petiole, the margins thin, sharp, often reflexed, the leaf-trace simple, branching in the base of the petiole, the midrib evident along the ventral surface of the lamina as a slight but distinctly angled ridge, and marked below by a whitish line, the veinlets alternate, rather prominent when dry, whitish below, divergent from the midrib at an angle of 20°, bent forward near the margin and connivent with the anterior veinlet, the areolae thus formed simple, 3–4 mm. broad, elongate-rhomboid, the oblique sides about 20 mm. long, the marginal and costal sides about 10 mm. long; sporangia and paraphyses borne along the intersected portions of the veinlets, forming a continuous shallowly crenate soral line, 2–3 mm. distant from the margin, superficial or scarcely immersed, the spores diplanate, the paraphyses pyriform or cyathiform, rounded at first, but soon collapsing and becoming angular and ribbed. (PLATE 17.)

TYPE collected at Santa Barbara, BOLIVIA, altitude 5,500 feet, *R. S. Williams 1337*, 30 August 1902.

Vittaria latifolia is interesting as having the broadest laminae in proportion to their length of any species of the genus. It is so different from the ordinary type of *Vittaria* as represented by *V. lineata* that one might well be excused for regarding it as a different genus until the vittarioid venation is discovered. It represents an extreme development of the type seen already in *V. remota* and *V. Gardneriana*, but is well differentiated from these not only by its greater width, but by scale characters as well.

5. VITTARIA STIPITATA Kunze, Linnaea **9**: 77. 1835.

Rhizome erect, 1–2 cm. long, usually branching several times, the branches fasciculate, forming a close cluster 0.5–2 cm. thick, radially symmetrical, the scales linear, unicostate, or sometimes with 2–3 costae at the base, thick and bent.

Leaves pendent, one or two on each rhizome branch, 12–100 cm. long, the lamina linear, parallel-sided through much of its length, gradually narrowed above and below (about 0.75 mm. thick), the surfaces usually smooth and plane, or sometimes with a low median ridge along the ventral surface, the margins thick, usually blunt, the petiole 3–9 cm. long, about 1 mm. thick, brown or purplish-brown, hard, partly hollow, terete below becoming flattened dorsiventrally and angled in the upper part, the leaf-trace single, dividing to form the midvein and two lateral veinlets in the base of the petiole, the veins not evident on either surface of the lamina, the veinlets intersecting 2.5–4 cm. apart, along the margin, the areolae with the long axes longitudinal; soral lines straight, 0.5 mm. from the margin, in deep narrow grooves inclined to the margin. (PLATE 18.)

TYPE from PERU: (definite locality not given), *Poeppig 176*.

SPECIMENS EXAMINED, UNDERWOOD FERN HERBARIUM. BOLIVIA: Tigre Pata, 2,000 m., *R. S. Williams 1338*, 10 F 1902; Yungas, *H. H. Rusby 340*, 1885; Yungas, *M. Bang 353*, 1890. BRAZIL: prope Rheos, *Martius 386*, Herb. Flora Brazil, 1839. COLOMBIA: *H. H. Smith 1112* in part, 20 Au 1898 or 1899; Sierra de Onaca, Sta. Marta, "moderately common on trees in forest," *2538;* Minca Estate, near stream, Sta. Marta, 800 m. (2 sheets); Atrato and Truando, *Schott 61*, D 1857. COSTA RICA: *L. C. Wercklé*, 1901–1905; *Tonduz 12782* (scraps), N 1898. CUBA: *C.*

Wright 865, "Cuba orientali, prope villam Monte Verde; in arboribus," Ja–Ju 1859; forested slopes of the Finca las Gracias, Yaleras, Oriente, about 500 m.; on trunk of dead (lodged) tree, *W. R. Maxon 4476*, 5 My 1907. JAMAICA: vicinity of Troy, 600–660 m., *W. R. Maxon 2972*, 30 Je 1904; on trees over Ginger and Ugly Rivers, St. Mary's Parish. *G. S. Jenman*, 1874–79. PANAMA: above Penonome, 650–1,000 m., *R. S. Williams 456*, Mr 1908; Cana and vicinity, 1,900 m., *R. S. Williams 890*, Ap-Je 1908. PERU: Cumbassauma Mts. (scrap); *Poeppig 176* (scraps of type).

SPECIMENS EXAMINED, U. S. NATIONAL HERBARIUM. BOLIVIA: Yungas, *Bang 353*. BRAZIL: *Riedel;* San Paulo, Rais da Serra, "ad arbores," *L. Wackett*, 1907; COLOMBIA: *H. H. Smith, 2568*, 800 m.; COSTA RICA: *Wercklé* (2); Las Vueltas, Tucurrique, 630 m., *A. Tonduz 12782*, N 1898. CUBA: *C. Wright 865; W. R. Maxon 4476*. ECUADOR: Rio Talesa, 1,400 m., *J. Rimhart 72*.

SPECIMENS EXAMINED, EATON HERBARIUM. COLOMBIA: Atrato and Truando *A. Schott 61*, D 1857. CUBA: Cuba orientali, *C. Wright*, Ja-Je 1859. (2). VENEZUELA: Tovar, 2,000–2,300 m., *A. Fendler 259*.

SPECIMENS EXAMINED, HERBARIUM OF THE BOTANISK MUSEUM. BRAZIL: San Paulo, Santos, *Riedel*. *H. Mosen 3526*. CENTRAL AMERICA: *Oersted*. COLOMBIA: *Moritz 143* in part.

The great variation in length of specimens included under this species is one of the most notable facts. There can, however, be no doubt as to the identification of all the material as this species. The unicostate scales give a simple and very easily applicable test by which it can be separated from the following species or any other of this group. It seems to grow under a wide range of conditions, this presumably accounting for the variation in size, the small specimens being probably only physiological forms. In the West Indies it rarely reaches as full development as in South America, but even the smallest specimens measured were usually fertile.

6. VITTARIA RUIZIANA Fée, Mém. Foug. **3**: 16. *pl. f. 3*. 1852

Vittaria Moritziana Mett. Ann. Sci. Nat. Bot. V. **2**: 207. 1864.
Vittaria Orbignyana Mett. in Kuhn, Linnaea **36**: 66. 1869.
Vittaria longipes Sodiro, Crypt. Vasc. Quitenses 417. 1893.

Rhizome erect, 1–2 cm. long, unbranched or branching to form a close cluster of shoots, each radially symmetrical, the scales 6–10-costate at the base, the median costa much thickened in the upper portion of the scale. Leaves pendent, 1–5 to each shoot, 40–70 cm. long, the petiole 5–15 cm. long, atropurpureous, hard, partly hollow, flattenedto the base, becoming 2-angled toward the lamina, the scales very narrow and elongate, 1–4-costate, the lamina linear, parallel-sided through most of its length, 4–10 mm. broad, narrowed gradually above and below, the dorsal surface plane or nearly so, the ventral surface with a broad low median ridge, the margins usually thin and sharp, often reflexed in old leaves, the leaf-trace single, dividing in the base of the petiole, the veins not evident on either surface of the lamina, the veinlets intersecting about 3.5 cm. apart along the margin, the areolae linear-rhomboid, the longitudinal sides about 3.5–4 cm. long, the oblique sides 2.5–3 cm. long. Soral lines straight, about 1–1.25 mm. from the margin, in a shallow open groove. (PLATE 19.)

TYPE from PERU: (definite locality not given), *Ruiz*.

SPECIMENS EXAMINED. COLOMBIA: Tablazo, Tuluá, *I. F. Holton 60*, 26 O 1853, "*V. stipitata*," "et in Ibaque" (U); Santa Marta, *H. H. Smith 1112* in part (N); *Lindig* (scrap, U). ECUADOR: S. Domingo, *Sodiro*, "*V. stipitata*." VENEZUELA: Tovar, *Moritz 143, 143b* (scraps, U); Tovar, *Fendler 259*, 1854–5, "*V. stipitata*" (E).

For *V. Moritziana*, Mettenius cites as type: Canoas, COLOMBIA, *Lindig 319;* for *V. Orbignyana:* Yungas, BOLIVIA, *d'Orbigny 229*. For *V. longipes*, Sodiro cites as type-locality: subandine woods of western range in the valley of Nanegal, near Anca (translated).

As may be seen from the synonymy this species has been recognized as distinct by several writers. The material of it is rather scanty, indicating that it must be rare. It furnishes an especially good illustration of the habit of writers of describing species of *Vittaria* on very insufficient data. It is possible of course that there may be more than one species represented under this name, but there are not now sufficient data for such differentiation, even on the basis of the most careful microscopic study, although much less than that was counted sufficient for the original descriptions.

The species is easily distinguishable from *V. stipitata* on the basis of the scales, which are broad, many-costate, and of two sorts.

The margins are also usually sharper than those of *V. stipitata*, and the sporangia are borne in shallower grooves.

7. Vittaria Williamsii sp. nov.

Rhizome erect, 0.5–1 cm. long, 2–2.5 mm. thick, unbranched, radially symmetrical, the scales small, lanceolate, blackish-costate at the base. Leaves 1–3, 25–70 cm. long, rather thick and rigid when dry, the petiole 10–15 cm. long, hard, terete or nearly so at the base, soon becoming flat and angled, hollow above the base, atropurpureous or green along the anterior ventral portion of the stipe, the lamina linear-lanceolate, 8–14 mm. broad, narrowed gradually both ways from the middle, plane or somewhat recurved, the apex somewhat acuminate, the margin thin, sharp, plane, the lower dorsal surface marked with a median purplish stripe extending up from the petiole: leaf-trace one, dividing in the base of the petiole, the midvein not evident on the surface, the veinlets not evident on the surface, intersecting 1.5–2 mm. apart, the areolae about 2 mm. broad, linear-rhomboid with the long axes at an angle of about 15° to the midvein; sporangia in a straight or slightly sinuate line, about 1 mm. from the margin, in an open very shallow groove. (PLATE 20.)

TYPE from BOLIVIA, Santa Ana, altitude 1,800 meters, *R. S. Williams 1349*, 29 Jl 1902.

Also collected at Yungas, BOLIVIA, altit. 1,300 m., *H. H. Rusby 339*. 1885.

It is always a pleasure to work with Mr. Williams's specimens owing to the excellence of their preparation. The present species is no exception. It is as well distinguished from the other species of this subgenus as is *V. latifolia* also collected by him. Its association is, however, clearly with the species of the *stipitata* alliance of which it is the broadest example.

SPECIES INQUIRENDA

Vittaria Bommeri Christ, Bull. Herb. Boiss. II. 5: 11.

I have seen a fragment of the original specimen of this species through the kindness of His Highness, Prince Roland Bonaparte, in whose herbarium it is deposited. I have not, however, enough to determine certainly the specific characters, although it appears to be close to *V. Gardneriana* Fée.

Explanation of plates 15-20

Unless otherwise noted, the reductions and magnifications are as follows: tracings of whole plants and leaves reduced one-half; leaf and stem sections enlarged twelve times; scales enlarged about thirty-five times. The sections and scales were drawn by means of a camera lucida.

PLATE 15. VITTARIA GARDNERIANA Fée

FIG. 1. Whole plant, showing general habit and soriation.
FIG. 2. Cross-section through leaf in fertile part.
FIG. 3. Cross-section through petiole, showing 2-angled character.
FIG. 4. Single broad leaf from another plant, showing venation.
FIG. 5. Cross-section same leaf, showing similarity to *V. remota* Fée.
FIG. 6. Cross-section of petiole of same leaf.
FIG. 7. Cross-section of another leaf through fertile portion.
FIG. 8. Cross-section of petiole of same leaf.
FIG. 9. Typical scale.

Specimens figured: figures 1–6, *H. H. Smith 1112*, Santa Marta, Colombia (this number includes also *V. Moritziana* Mett.—see *plate V*, and *V. stipitata* Kunze—see *plate IV, fig. 20*); 7–9, Gardner, Organ Mts., Brazil 1837, *probably part of type collection.*

PLATE 16. VITTARIA REMOTA Fée

FIG. 1. Whole plant, showing general habit, venation, and soriation.
FIG. 2. Cross-section through fertile part of leaf.
FIG. 3. Cross-section of leaf just below fertile part.
FIG. 4. Cross-section of leaf still lower down than preceding.
FIG. 5. Cross-section through petiole more than 2 mm. above stem, to show angled character.

FIG. 6. Cross-section through petiole just after it leaves the stem. The angles are not developed at this point, but the single leaf-trace has already given off the lateral veinlets.

FIG. 7. Cross-section through stem, showing origin of petiole—at left—and a still younger leaf-trace—at right. A root is shown just leaving the stem at the lower side.

FIG. 8. Cross-section of a broader leaf through the fertile part, showing that the sporangia are borne in a slight depression.

FIGS. 9–12. Cross-sections of same leaf, comparable to those in figs. 4–6, but each respectively lower than the corresponding one in the first series.

FIGS. 13–15. Tracings from leaves showing abnormal modifications in the venation.

Specimens figured: figure 1, *P. Wilson 81*, Porto Rico; 2–7, *L. M. Underwood*, Jamaica, 1903; 8–12, *R. S. Williams 889*, Panama; 13–15, from a plant grown at the N. Y. Botanical Garden, probably self-sown from Jamaica spores.

PLATE 17. VITTARIA LATIFOLIA Benedict

FIG. 1. Whole plant, showing general habit, venation, and soriation.

FIG. 2. Cross-section of leaf through fertile part, showing very slight depression in which sporangia are borne.

FIG. 3. Cross-section of leaf below fertile part.

FIG. 4. Cross-section of petiole about 2 mm. above stem.

FIGS. 5–8. Successive cross-sections of petiole less than 2 mm. from stem, showing single leaf-trace and its division.

FIG. 9. Cross-section of stem, showing origin of a petiole and a leaf-trace.

FIG. 10. Stem scale, showing cilia, most of which have been broken off.

All the figures were drawn from type material, *R. S. Williams 1337*, Bolivia.

PLATE 18. VITTARIA STIPITATA Kunze

FIG. 1. Whole plant, showing general habit and soriation.

FIG. 2. Cross-section of leaf in fertile part.

FIG. 3. Cross-section of leaf below fertile part.

FIGS. 4 and 5. Cross-sections of petiole more than 2 mm. above stem.

FIG. 6. Cross-section of stem showing origin of a petiole with a leaf-trace not yet divided.

FIG. 7. Whole plant, about the smallest seen.

FIG. 8. Cross-section of leaf of larger plant of same collection number.

FIG. 9. Single leaf attached to stem; the leaf was about the longest and broadest observed.

FIG. 10. Cross-section through fertile part of same leaf shown in fig. 9.

FIG. 11. Cross-section through fertile part of another somewhat different leaf.

FIGS. 12–14. Cross-sections of same leaf about where the blade narrows into the petiole. The shaded strip below represents the band of collenchyma which runs part way up the blade.

FIGS. 15 and 16. Scales with an unusual amount of cell development.

FIGS. 17–19. Scales of the usual type.

FIG. 20. An old scale from which the softer parts of the cells have been lost.

Specimens figured: figures 1–6, *W. R. Maxon 4476*, Cuba; 7 and 8, *R. S. Williams 1338*, Bolivia; 9 and 10, *H. H. Smith 2568*, Colombia; 11–14, 17–19, *R. S. Williams 890*. Panama; 15 and 16, *Wercklé*, Costa Rica; 20, *H. H. Smith 1112*, Colombia.

PLATE 19. VITTARIA RUIZIANA Fée

FIG. 1. Whole plant, showing general habit, venation, and soriation. The petioles are unusually short in this plant.

FIGS. 2 and 3. Cross-sections through fertile part of a leaf, showing pointed margin, and the sporangial groove, which is much shallower than in *V. stipitata* Kunze.

FIG. 4. Cross-section through petiole more than 2 mm. above stem, showing heavy collenchymatous development with aerated central portion. The leaf-trace has divided into the midvein and two lateral veinlets.

FIG. 5. Cross-section through fertile part of leaf of type collection.

FIG. 6. Cross-section through fertile part of an unusually narrow leaf.

FIGS. 7 and 8. Cross-sections through petiole more than 2 mm. above stem.

FIG. 9. Cross-section through petiole very close to stem, and before simple leaf-trace has divided.

FIG. 10. Stem scale.

FIG. 11. Petiole scale.

Specimens figured: figures 1–4, *H. H. Smith 1112* (in National Herbarium), Colombia; 5, 11, *Moritz 143*, Tovar, Venezuela (type 6–10, *Sodiro*, Ecuador).

PLATE 20. VITTARIA WILLIAMSII Benedict

FIG. 1. Single leaf, showing soriation and the extreme of length noted.

FIG. 2. Whole plant (*type*), showing general habit, venation, and soriation.

FIG. 3. Cross-section of half of leaf in fertile part, showing very slight depression where sporangia are borne.

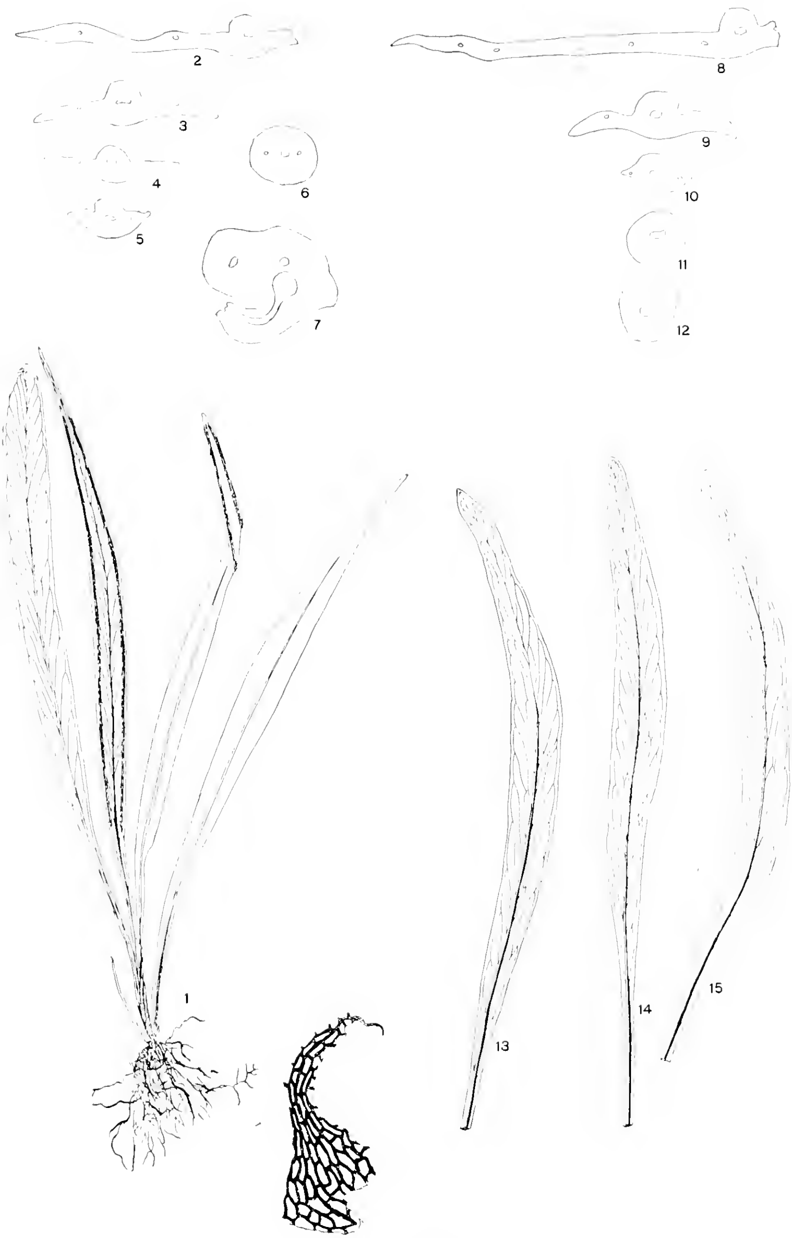
FIG. 4. Cross-section through leaf below fertile part.

FIG. 5. Cross-section through petiole more than 2 mm. above stem.

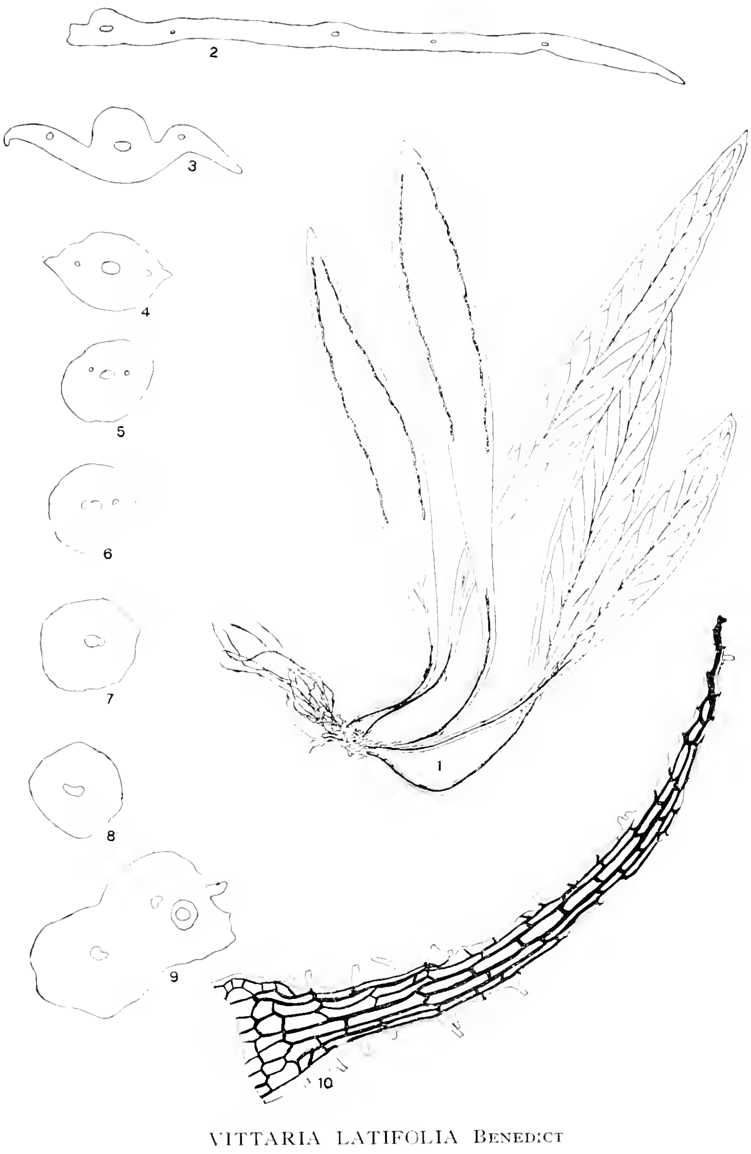
FIG. 6. Scale showing the very heavily thickened apical portion.

Specimens figured: figure 1, *Rusby 339*, Yungas, Bolivia; 2–6, all from type material.

VITTARIA GARDNERIANA FÉE

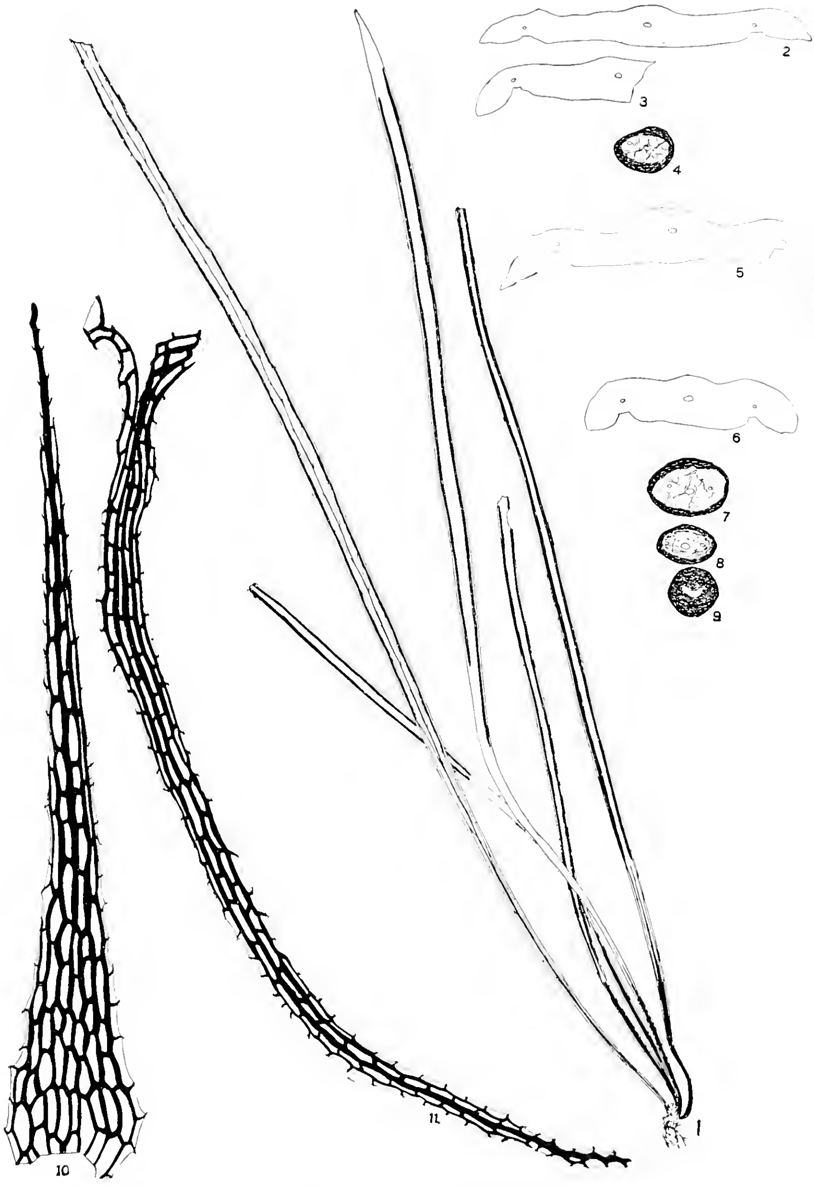


VITTARIA REMOTA FÉE



VITTARIA LATIFOLIA BENEDICT

VITTARIA STIPITATA KUNZE



VITTARIA RUIZIANA FÉE

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PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION

III. FORMATIONS IN THE ALPINE ZONE

P. A. RYDBERG

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Phytogeographical notes on the Rocky Mountain region
III. Formations in the alpine zone

P. A. Rydberg

As the writer is no ecologist and has dealt very little with plant societies, he knows that this paper will scarcely stand muster before experts in that line. The notes are mostly taken down from memory and casual observations made while collecting with taxonomy wholly in view. They must therefore be in many respects imperfect and in some cases faulty. As I have occasionally criticized ecologists and phytogeographers, even severely, for their work, I should expect criticism when I myself enter their field, but right here I wish to say that I not only expect, but rather wish, somebody to point out my errors or shortcomings, so that the truth may be had. My only excuse for writing on "Formations" is that very little has been published in this line on the Rocky Mountain region, and in every case it has been only small local regions that have been treated. I know that Professor Clements has been working for years on the ecology of the Pikes Peak region and when his book is out, I expect to see an expert treatise on the subject; but until then let us amateurs scribble down and publish our notes, and probably they may be of some value to the professional ecologists, and, in the meantime, of general interest to the plant-lovers.

Clements in his little article "Formation and Succession Herbaria"* has given the best list of plants, arranged according to regions, formations, and successions, ever published from the Rocky Mountain region. The value of this list is increased by the fact that he has distributed a collection of exsiccatae illustrating it. Of course, his paper treats only of the region of Pikes Peak, Colorado. He assigns the following formations to the alpine region:

Alpine meadow formation
Alpine bog formation

* University [Nebraska] Studies 4: 329–355. 1904

Alpine lake formation
Alpine mat formation
Alpine rock-field formation

While my observations at other places in the Rockies agree essentially in most respects with Professor Clements' arrangement, it cannot be applied without modification to all localities in the Rockies, not even to all in Colorado. When the whole of the southern Rockies is considered, some modifications must be made, and if the alpine region of the northern Rockies is included, still more adjustment is needed. Here there are found formations of ericaceous plants, consisting of undershrubs, if not, as in the Alps, of shrubs. Perhaps I lay too much stress upon the moisture in the ground and soil, and therefore would be inclined to subdivide Professor Clements' alpine meadow formation.

The Rocky Mountains have received their name from the numerous loose rocks that cover their tops and sides. In naming plants from the Rocky Mountains, the specific name usually used has been *scopulorum*. This is really a misnomer, for it is not from *scopulum* (a projecting cliff) but from *saxum* (the loose rock), that the Rockies were named. When the mountain disintegrates it breaks up into large blocks. These in the Rockies cover large fields, or, as they are mostly on the slopes, they are often more or less in motion and are usually known as "rock-slides." The first form of vegetation which appears on a newly formed rock-slide is, of course, lichens. Whenever there has been deposited a little humus between the rocks a few flowering plants appear, mostly perennials, with strong root systems or with strong rhizomes. Thus arises the first formation, the

ROCK-SLIDE FORMATION

If the rocks disintegrate still more, they become broken up into smaller pieces and more humus is added and there arises a gravel-field. If the disintegrated portion is rather thin, as it usually is on the top of the peaks and along the ridges, the formation is a xerophytic one, as little of the water from the melting snow is retained. So we have our second formation, which corresponds to Dr. Clements' alpine mat formation. This may be called the

Mountain crest formation

If the gravel field or rock field is situated on the sloping mountain side, either under a snowdrift or along the course of the drainage, in other words where the moisture is greater and where more humus has a chance to gather, we have our third formation, which I shall call in lack of a better word the

Mountain seep formation

This was included by Clements in the mountain meadow. While the mountain seeps have many plants in common with the meadows, there are found others wholly characteristic of these seeps, as for instance certain species of the saxifrage family and several willows. Where the ground is less sloping and the humus has had chance to gather still more, there is found the

Alpine meadow formation

If the drainage is imperfect and the water becomes stagnant, the next formation occurs, the

Alpine bog formation

or if deeper, the

Alpine lake or pond formation

To this can also be added special formations. There are certain plants that grow only in the crevices of exposed cliffs. Hence, the

Cliff formation

Another is found only below and around the melting snowdrifts, the

Snow-drift formation

Of these the rock-slides and mountain crest formations are decidedly xerophytic; the cliff formation mostly mesophytic but often xerophytic, the meadow and mountain seep formations mesophytic or the latter usually hydrophytic; of course, the bog and lake formations are hydrophytic.

1. Alpine mountain crests

I shall begin with this formation, as it is perhaps the most characteristic of the alpine formations. The plants are nearly all very low, only a few inches high, but what they lack in size they make up in the coloration of their flowers. It is strange that the alpine plants should have such bright colors, when insects are comparatively rather scarce and the plants have all the facilities of wind-pollination. Most of the plants of this formation grow in clumps or mats, even the grasses and sedges growing there are more or less tufted.

One of the most common and, at the same time, conspicuous plants of this formation is *Alsinopsis obtusiloba*. It is not conspicuous on account of its size or the beauty of its flowers, but on account of its mode of growth. It is found nearly everywhere in the most exposed places, in the crevices of the rocks or between the boulders, wherever the roots can find a foothold, even where there is scarcely a trace of soil. It grows in tussocks or mats from 1 to 12 inches in diameter, the stem lying flat on the rocks and only the peduncles rising 1–2 inches above them. *Draba oligosperma*, *D. andina*, and *D. densiflora* have a similar habit but grow in smaller mats and are more frequent between smaller stones and gravel on the ridges. In similar situations are found larger mats of *Dryas octopetala* and (in the northern Rockies) *D. Drummondii*, and smaller colonies of *Potentilla quinquefolia* and *Phlox caespitosa*. The latter is rather rare in the southern Rockies where its place is taken by a closely related species, *Phlox condensata*. *Silene acaulis*, the moss campion, resembles *Alsinopsis obtusiloba* in habit, but prefers places with more humus. The vegetation of the bare rocks consists mostly of the above mentioned *Alsinopsis* and less frequently *Sedum stenopetalum* and scattered patches of *Draba* and *Phlox*.

Two of the most widely distributed plants growing in gravelly places on the tops of the mountains are *Erigeron simplex* and *E. multifidus*. The following three species, closely related to the latter, are found in similar situations, but *E. trifidus* is more limited to the northern portion, extending even into the Arctics. *E. pinnatisectus* is confined to the southern Rockies and the original *E. compositus* to the northwest. In similar situations we find also *Smelowskia americana* and *Trifolium dasyphyllum;* in the southern Rockies also *Androsace carinata*, *Thlaspi coloradense*, *T. purpurascens*, and *Eritrichium argenteum;* and in the northern Rockies, *Douglasia montana* and *Eritrichium elongatum*. *Acomastylis* (*Sieversia*) *turbinata* is found in a depauperate form on the crests and in better development in the meadows. The beautiful paint-brushes, *Castilleja occidentalis* and *C. Haydeni* (southern Rockies), are found mostly on the slopes, connecting the crests with the meadows.

Of the grasses, *Poa rupicola*, *P. Pattersonii*, *P. Lettermanni*, *Festuca brachyphylla*, *F. saximontana*, *F. supina*, and *Agropyron Scribneri* are mostly limited to the crest themselves, while *Trisetum subspicatum*, *Deschampsia curtifolia*, *Agropyron andinum*, and *A. latiglume* frequent the slopes or even run down into the meadows.

The following plants are the most common and most generally distributed alpine xerophytes belonging to this formation:

**Calamagrostis purpurascens*
Trisetum subspicatum
Deschampsia curtifolia
Poa rupicola
**Poa crocata*
Festuca brachyphylla
Festuca saximontana
Agropyron Scribneri
Oreobroma pygmaea
Alsinopsis obtusiloba
Silene acaulis
Draba oligosperma
Draba andina
Draba densiflora
**Draba aurea*
Smelowskia americana
**Sedum stenosepalum*
**Heuchera parvifolia*
Potentilla quinquefolia
Acomastylis turbinata
**Dasiphora fruticosa*
Dryas octopetala
**Dasystephana affinis*
Trifolium dasyphyllum
**Phlox caespitosa*
Castilleja occidentalis
Antennaria media
**Antennaria aprica*
**Senecio Purshianus*
Erigeron simplex
Erigeron compositus
Erigeron multifidus
Erigeron trifidus

The following are common and important plants of this formation in the southern Rockies, but lacking or rare in the northern. Those with the asterisks are mostly found near or below the timber-line, those with the dagger are found in the northern Rockies but are rare:

* Those with asteriks are mostly found near the timber-line and also below.

†*Poa Pattersoni*
Poa Lettermanni
Avena Mortoniana
**Eriogonum xanthum*
Paronychia pulvinata
**Arenaria Fendleri*
Thlaspi coloradense
Thlaspi purpurascens
Cheirinia radiata
Cheirinia nivalis
Draba aureiformis
Draba chrysantha
Draba crassifolia
**Draba streptocarpa*
Draba saximontana
Androsace carinata
**Dasystephana Parryi*
Phlox condensata
Castilleja Haydeni
Pentstemon Hallii
†*Eritrichium argenteum*
Erigeron pinnatisectus
**Besseya plantaginea*
**Senecio Nelsonii*
Senecio Harbourii

The following are important plants of this formation in the northern Rockies but lacking in the southern:

Festuca supina
Agropyron andinum
Agropyron latiglume
Potentilla Macounii
Dryas Drummondii
Aquilegia Jonesii
Douglasia montana
Phacelia sericea
Phacelia alpina
Eritrichium elongatum
Dasystephana monticola

The following plants belong to this formation but are rather local:

Southern

Poa epilis
Festuca minutiflora
Arenaria Tweedyi
Cheirinia amoena
Draba crassa
Parrya platycarpa
Oreoxis humilis
Oreoxis Bakeri
Oreoxis alpina
Pseudocymopterus Tidestromii
Xylorrhiza coloradensis
Xylorrhiza Brandegei
Macronema pygmeum
Potentilla minutifolia
Potentilla tenerrima
Potentilla nivea
Potentilla nipharga
Potentilla paucijuga
Gormania debilis
Aragallus podocarpus
Aragallus Hallii
Chaenactis pedicularia
Chaenactis alpina
Senecio petrocallis
Chrysopsis alpicola

Northern

Douglasia nivalis
Phacelia Lyallii
Antennaria sedoides
Macronema Lyallii

2. ALPINE ROCK-SLIDES

Many parts of the Rocky Mountains are covered by loose rocks, often in more or less unstable conditions, sometimes forming sliding fields or moving together with the snow avalanches. These are not wholly without vegetation and there are certain plants that are characteristic of such rock-slides, scarcely growing anywhere else.

The most characteristic plant of the rock-slides is, perhaps, *Claytonia megarrhiza* with its large red root lodged far down among the rocks. Another is *Alsine americana* of the northern Rockies, which has a slender rootstock, sending up long shoots among the rocks, the proper leaves and flowers crowded at the ends of the branches. *Senecio carthamoides* and *C. Fremontii*, *Telesonix Jamesii* and *T. heucheriforme*, *Ribes montigenum* and *R. parvulum* are also confined to the rock-slides, the former of each pair found in the southern, the latter in the northern Rockies. *Hulsea carnosa* also I found only in the rock-slides of Montana and Yellowstone Park. *Primula Parryi* and *Oxyria digyna* frequent the rock-slides, but are not confined to them, the former being even found in the woods. The other rock-slide plants are rather local.

The following constitute for the most part the rock-slide vegetation:

Southern Rockies

Polemonium speciosum
Polemonium confertum
Primula Parryi
Claytonia megarrhiza
Telesonix Jamesii
Heuchera Hallii
Ribes montigenum
Pentstemon Hallii
Pentstemon Harbourii
Aquilegia saximontana
Syntheris plantaginea
Senecio carthamoides
Oxyria digyna
Selaginella densa
Machaeranthera Pattersoni
Pseudopteryxia anisata
Senecio invenustus

Northern Rockies

Claytonia megarrhiza	*Hulsea carnosa*
Telesonix heucheriforme	*Senecio Fremontii*
Oxyria digyna	*Alsine americana*
Selaginella densa	*Ribes parvulum*
Pseudopteryxia Hendersonii	*Polemonium viscosum*

3. Alpine cliffs

While the following plants are found elsewhere, they are characteristic of the crevices of exposed cliffs:

**Chondrosea Aizoon*	*Oxyria digyna*
**Leptasea austromontana*	*Aquilegia saximontana*
Antiphylla oppositifolia	*Polemonium pulcherrimum*
Anticlea coloradensis	*Polemonium delicatum*
Senecio petrocallis	

4. Alpine mountain seeps

This formation usually is found between the mountain crests and the meadows, but is more moist than either. Often the mountain crest or mountain slope formation gradually changes into the meadow. This is usually the case where no melting snowdrift supplies the slope with more moisture throughout the summer; but where water is dripping or seeping down from the snow, along brooks, and above subterranean water courses, there is developed a formation, which as far as moisture is concerned could be classified with the wet meadow, but the ground is more rocky, the soil consists more exclusively of humus and most of the plants are different from those of the true meadow. The grasses and sedges are fewer both in number and in species, but otherwise the same as those of the meadow, although the three Poas mentioned below are characteristic of these seeps, rather than of the meadows. Characteristic plants of these seeps are the alpine willows, alpine clovers, *Sibbaldia procumbens*, *Rhodiola*, species of *Ranunculus*, *Senecio*, *Polemonium* and *Juncus*, *Taraxacum scopulorum*, *Mertensia alpina* and its relatives, *Myosotis alpestris*, and, above all, many species of *Saxifraga* and its allies.

In the northern Rockies there is found a plant association that may be counted here. On northern cold mountain slopes of

Montana, with a good deal of moisture, sometimes whole acres are covered with *Cassiope Mertensiana*. Except the ericaceous bog formation, made up of *Phyllodoce*, *Kalmia*, and *Ledum*, this is the only poor representation of the shrubby ericaceous formation, so characteristic of the Alps. This association of *Cassiope* suggests in many respects the arctic tundra. I have not visited the extreme northern part of the Rockies in British America, but I suspect that *Cassiope tetragona* and *Harrimanella hypnoides* there form similar associations. The only other plants in the alpine regions of the Rockies that I know of as forming similar mats are the dwarf alpine willows, *Salix saximontana*, *S. nivalis*, *S. petrophila*, *S cascadensis*, and *S. Dodgeana*. The last, the smallest willow of the world, I found forming similar mats near the top of Electric Peak, southern Montana, at an altitude of 11,000 feet. . When it was first discovered I did not know that I had been walking on top of a willow forest before I dropped down on my knees, began to poke among the leaves, and found some minute catkins.

The following plants are common in the seep throughout the Rockies:

Poa alpina
Poa cenisia
Poa arctica
Juncoides spicatum
Salix petrophila
Salix saximontana
Oxyria digyna
Alsinopsis propinqua
Alsine baicalensis
Alsine laeta
Muscaria adscendens
Micranthes rhomboidea
Leptasea flagellaris
Sibbaldia procumbens
Trifolium Brandegei
Trifolium Parryi
**Vaccinium caespitosum*
Primula angustifolia
Polemonium pulcherrimum
Sagina saginoides
Ranunculus pygmaeus
Ranunculus hyperboreus
**Aquilegia coerulea*
Draba fladnizensis
Rhodiola integrifolia
Saxifraga cernua
Cerastium behringianum
Mertensia alpina
Myosotis alpestris
Taraxacum scopulorum
Artemisia scopulorum
Senecio cymbalarioides
Juncus Drummondii
Juncus Parryi
Juncus triglumis
Juncus castaneus
Chondrophylla americana

The following are important plants belonging to this formation, but limited to the southern Rockies:

Ranunculus Macauleyi
Rhodiola polygama
Cerastium Earlei
Trifolium Brandegei
Relatives of *Trifolium dasyphyllum* (*T. stenolobum*, *T. attenuatum*, *T. bracteolatum* and *T. lividum*)
Anthropogon barbellatum
Polemonium confertum and its relatives
Micranthes arnoglossa
Leptasea chrysantha
Muscaria delicatula
Tonestus pygmaeus
Oreochrysum Parryi
Artemisia saxatilis
Artemisia Pattersonii
Saxifraga debilis
Mertensia brevistyla
Mertensia viridula
Mertensia lateriflora
Mertensia Bakeri
Pentstemon stenosepalum
Salix pseudolapporum
Senecio Holmei
Senecio taraxacoides
Senecio Soldanella
Senecio crocatus

The following are common in the northern Rockies, but not found in the southern:

Salix cascadensis
Salix nivalis
Draba lonchocarpa
Draba nivalis
Saxifraga rivularis
Muscaria caespitosa
Micranthes stellaris
Micranthes Rydbergii
Micranthes hieracifolia
Dasystephana glauca
Polemonium viscosum
Ranunculus saxicola

The following belong to this formation but are merely local or rare:

Southern

Delphinium alpestre
Alsinopsis quadrivalvis
Alsinopsis Rossii
Sagina nivalis
Alsine polygonoides
Chrysosplenium tetrandrum
Muscaria micropetala
Micranthes brachypus
Micranthes Vreelandii
Leptasea Hirculus
Polemonium Brandegei
Draba Parryi
Cerastium pulchellum
Mertensia Parryi
Artemisia spithamaea
Artemisia Parryi

Northern

Salix Dodgeana
Alsinopsis quadrivalvis
Alsinopsis Rossii
Alsine polygonoides
Chrysosplenium tetrandrum
Muscaria monticola
Micranthes crenatifolia
Micranthes Vreelandii
Leptasea Hirculus
Leptasea Van Bruntiae
Polemonium parviflorum
Chondrophylla Fremontii
Artemisia spithamaea

5. ALPINE MEADOWS

The more or less mesophytic part of the alpine region may be called the alpine meadow. It is found in the less sloping parts of the mountains, where more humus and alluvial soil has had a chance to collect. Of course, the more characteristic plants in such localities are grasses and sedges.

The most important and most common of the grasses are the different species of *Poa*, *Phleum alpinum*, *Trisetum subspicatum*, *Agropyrum biflorum*, *Festuca saximontana*, and in the wetter places, especially on brook banks, *Deschampsia caespitosa* and *D. alpicola*. On the slopes *Festuca ingrata* and *F. Thurberi* are also important, but not to such an extent as they are in the subalpine and mountain region. The sedges and rushes occupy mostly the wetter parts, which stand on the borderland of bogs. There are, however, localities which must be classified as meadows, where the predominating plants are other than grasses and sedges. In many places many acres are covered with mostly *Acomastylis turbinata* or *Rydbergia grandiflora* in the southern, and *Acomastylis sericea* in the northern Rockies.

The common species of the meadow formations throughout the whole region are the following:

Phleum alpinum
Deschampsia caespitosa
Trisetum subspicatum
Trisetum majus
**Danthonia intermedia*
**Poa longiligula*
**Poa Buckleyana*
**Poa epilis*
Poa leptocoma
**Festuca ingrata*
Festuca saximontana
Festuracubra
**Agropyron caninum*
Agropyron biflorum

Juncoides spicatum
Juncoides parviflorum
Bistorta bistortoides
Bistorta linearifolia
Alsine laeta
Cerastium behringianum
Thalictrum alpinum
**Aquilegia flavescens*
Clementsia rhodantha
**Potentilla diversifolia*
Potentilla glaucophylla
Potentilla rubripes
Acomastylis turbinata
Sieversia ciliata
**Agrostis hyemalis*
**Alopecurus aristulatus*
Juncus Drummondii
Juncus Parryi
Juncus triglumis
Juncus castaneus
**Primula Parryi*
**Vaccinium scoparium*
**Vaccinium oreophilum*
**Androsace subumbellata*
Amarella plebeja
**Amarella strictiflora*
**Castilleja rhexifolia*
**Castilleja lauta*
**Castilleja lancifolia*
Besseya alpina
**Campanula Parryi*
Campanula petiolata
Trifolium nanum
Trifolium Parryi
Lloydea serotina
**Tium alpinum*
**Atelophragma elegans*
Aragallus deflexus
Phacelia sericea
Phacelia ciliosa
**Pedicularis racemosa*
Pedicularis Parryi
Aster apricus
Rydbergia grandiflora
**Senecio pseudaureus*
Solidago oreophila
Solidago decumbens
Solidago ciliosa
**Erigeron glabellus*

The following are common plants of the alpine meadow, but are restricted to either the southern or the northern Rockies:

Southern

Blepharoneuron tricholepis
Deschampsia alpicola
Poa alpicola
Poa Grayana
**Poa Sheldoni*
Poa pudica
**Festuca Thurberi*
Anemone zephyrea
**Sidalcea candida*
Draba streptocarpa
Angelica Grayi
Primula angustifolia
Polemonium speciosum
Polemonium confertum
Polemonium mellitum
Valeriana acutiloba
Castilleja brunescens
Campanula uniflora

Achillea subalpina
Arnica Parryi
**Senecio amplectens*
Oreochrysum Parryi
Pseudocymopterus purpureus
**Mertensia alpina*
Mertensia brevistyla
Aster alpinus

Northern

Tofieldia palustris
Juncoides arcticum
Juncoides arcuatum
Juncoides hyperboreum
Juncus biglumis
Drymocallis pseudorupestris
Acomastylis sericea
**Trifolium Haydeni*
Phacelia alpina
Angelica Roseana
Polemonium viscosum
Valeriana septentrionalis

6. Alpine bogs

The principal hydrophytic formation of the alpine regions are the alpine bogs or wet meadows, situated on the mountain sides where the drainage is imperfect or where the water supply is greatly increased by melting snowdrifts above. These are of two kinds, either sedge bogs, where grasses and sedges are predominant, or willow bogs where the principal species are shrubs. The latter are rare above timber-line in the southern Rockies.

Sedge bogs

Little needs to be said of the sedge bogs, as they resemble similar bogs in any part of the colder regions, only that the individual species vary. With the sedges are usually mixed in a considerable amount of grasses as *Alopecurus aristulatus*, *Calamagrostis Langsdorfii*, *Poa leptocoma* and *Poa reflexa*, the cotton grass, *Eriophorum gracile*, and other more conspicuous plants as the little red elephant, *Elephantella groenlandica*.

The principal plants of this formation are:

Carex (many species)
**Eriophorum gracile*
**Eriophorum polystachyum*
**Alopecurus aristulatus*
Calamagrostis Langsdorfii
Poa leptocoma
**Poa reflexa*
**Phleum alpinum*

* These are found only near the timber-line, otherwise belonging to the subalpine region.

Scirpus pauciflorus
Scirpus caespitosus
Bistorta bistortoides
Bistorta vivipara
Ranunculus affinis
Thalictrum alpinum
Vaccinium oreophilum
Primula Parryi
Swertia palustris
**Pyrola uliginosa*
Veronica Wormskjoldi
**Elephantella groenlandica*
Amarella scopulina
Amarella strictiflora
Antennaria nardina

To this formation belong also the following species restricted to a part of the region:

Southern	Northern
Caltha rotundifolia	*Caltha leptosepala*
Ranunculus stenolobus	*Caltha Cheledonii*
**Senecio atratus*	
Ligusticum Porteri	

WILLOW BOGS

These willow bogs are not exclusively alpine, as most of the species there are found also in the subalpine region. They are not so common in the southern Rockies as they are in the northern. In Colorado, the shrubby species consist mostly of *Salix glaucops* and *Betula glandulosa*, although other species of willows, as for instance *S. chlorophylla*, are not rare. *Kalmia microphylla* is very local there. In the northern Rockies the number of species is increased. More species of *Salix* are found and *S. chlorophylla* becomes more predominant. *Alnus sinuata* is added to *Betula glandulosa*. Sometimes, especially in pockets on the northern slopes, the predominant plants are ericaceous, viz., *Kalmia microphylla*, *Ledum glandulosum*, *Phyllodoce empetriformis*, and *P. glanduliflora*. In the Canadian Rockies evidently are added to these, *Arctuos* and *Oxycoccus*. The herbaceous plants are mostly the same as in the sedge bogs, *Elephantella* and *Pyrola uliginosa* being conspicuous, especially in the subalpine regions.

The shrubby plants characteristic of the willow bogs are the following:

Salix chlorophylla
Salix glaucops
Salix saximontana
Salix monticola

**Betula glandulosa*	*Phyllodoce glanduliflora*
**Alnus sinuata*	*Kalmia microphylla*
Phyllodoce empetriformis	**Ledum glandulosum*

In the Canadian Rockies are added to these:

Salix alexensis	*Salix Barattiana*
Salix arbusculoides	*Salix Drummondiana*

7. Snow drift formation

This special formation is made up of hydrophytic plants, nearly all of the family Ranunculaceae. The other plants are such as are only occasionally found in these peculiar situations. This formation could be included in the alpine seeps on account of their moisture, but the ground is neither rocky nor does it contain much humus. As a rule the soil is considerably clayey. In reality it is a part of the alpine meadow, modified by the slowly melting snowdrifts. The formation is found only in hollows or on gentle slopes, where large snowdrifts have lodged during the winter and the ground does not become bare before late in the summer. The grasses and most other meadow or bog plants could not withstand such severe conditions. Where the snowdrifts have been the ground is perfectly bare or nearly so, except for these peculiar plants, which appear as soon as the snow has melted and the ground has had time to thaw a few inches deep. Sometimes they even come up through the snow. Hence, the stories of the snow plants often heard of are not altogether "fakes."

This formation is principally made up of the following plants:

Southern	Northern
Ranunculus adoneus	*Ranunculus eximius*
Ranunculus alismaefolius	*Ranunculus alismaefolius*
Ranunculus stenolobus	*Caltha leptosepala*
Caltha rotundifolia	*Caltha Cheledonii*

8. Alpine lakes

The aquatic flora of the alpine region is rather meagre. All the phanerogams and fernworts found there are found also in the subarctic region, in fact, are boreal plants of wide distribution.

The flora of the alpine lakes is limited to the following phanerogams and fernworts:

Southern Rockies	Northern Rockies
Sparganium angustifolium	*Sparganium angustifolium*
**Potamogeton alpinus*	*Sparganium minimum*
**Utricularia vulgaris*	*Potamogeton alpinus*
Callitriche palustris	*Callitriche palustris*
Isoetes paupercula	*Isoetes Bolanderi*

In the alpine brooks are found *Catabrosa aquatica* and *Phippsia algida*, the latter having been collected at one locality in Colorado.

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NOTES ON ROSACEAE—VIII

PER AXEL RYDBERG

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Notes on Rosaceae—VIII

PER AXEL RYDBERG

DRYAS

Little has been added to the knowledge of this genus in the last eighty years. Only one species has been added, *Dryas tomentosa* Farr.

Dryas integrifolia Wahl. Many authors regard this as merely a variety of *D. octopetala*, as intermediate forms are met with, but these have only been found where the two species grow together and are probably all of hybrid origin. Nathorst* was inclined to regard these forms as hybrids, but he did not call them by a hybrid name, denoting them as *D. octopetala* f. *intermedia*. Hartz† held the same opinion, but apparently by a slip of the pen called them *D. integrifolia intermedia* Nathorst. This hybrid has also been collected in Alaska at Orca, Prince William's Sound, 1899, *Coville & Kearney 1191*.

Dryas octopetala L. Hartz, *loc. cit.*, admitted several varieties of *Dryas octopetala*, viz. var. *minor* Hook., var. *hirsuta* Hartz, and var *argentea* Blytt. The last one of these seems to be furthest from the type, but by no means deserving specific rank. Simmons described a similar form of *D. integrifolia*, viz. *D. integrifolia canescens*.

Dryas tomentosa Farr. This species is closely related to *D. Drummondii* and perhaps not distinct. It may be only a variety

* Öfvers. Kong. Sv. Vet. Akad. Hand. **41**[1]: 24. 1884.

† Medd. Groenl. **18**: 321. 1895.

standing in the same relationship to *D. Drummondii* as *D. octopetala argentea* Blytt stands to *D. octopetala*. This species has also been collected in the Canadian Rockies, *Macoun 65125*.

GEUM

Geum vernum (Raf.) T. & G. was originally described as *Stylopus vernus* Raf., and the writer is somewhat in doubt if this species should not be regarded as the type of a distinct genus. The habit is that of a typical *Geum*, but the receptacle in fruit becomes stalked above the hypanthium, and the bractlets are usually lacking. Occasionally, however, there are found minute bractlets in this species, and the receptacle is more or less stalked in *Geum rivale*. The generic characters of *Stylopus* do therefore break down, and it is perhaps better to regard it a *Geum*, especially as the general habit is not essentially different.

Geum virginianum L. This species has in general been very well understood. Murray, however, applied that name to *G. canadense* and redescribed the true *G. virginianum* as *G. laciniatum* Murr. Many have referred the latter synonym to *G. canadense* and Scheutz suggests that it may be the same as *G. agrimonioides* C. A. Mey., i. e. *G. Meyerianum* Rydb., but in my opinion it belongs to *G. virginianum* L.

Geum camporum Rydb. Some twenty years ago, the writer, when working over the Rosaceae of Nebraska, had trouble in determining some specimens of *Geum*, and did not know whether to refer them to *G. canadense* or to *G. virginianum*. These specimens had the thick leaves, the stout stem and branches, and the large fruiting head of the latter, but the receptacle was not glabrous and the achenes had the pubescence of *G. canadense*. When working up the material for the North American Flora, he found that the plant was more common in the prairie region of the Mississippi valley than was expected and that its range extended from Minnesota and South Dakota to Arkansas and Texas. As both *G. virginianum* and *G. canadense* are found in the region, *G. camporum* might be regarded as a hybrid of the two. These two have about the same distribution (except that *G. virginianum* is not found in Mexico), but *G. camporum* is not found except in the western part of their common range. It is, therefore, not probable that it is a hybrid, and it is more likely a distinct species. The following specimens belong to it:

KANSAS: Manhattan, 1892, *Norton;* Riley County, 1895, *Norton 137;* Olathe, 1892, *Hitchcock;* Fort Riley, 1892, *Gayle 522;* Emporia, 1891, *E. Smith;* Cowley County, 1899, *Mark White 54;* Lawrence, *W. C. Stevens.*

NEBRASKA: Lincoln, 1887, *Webber;* Nehawka, *Sweezey;* Sargent Bluffs, 1853 or 1854, *Hayden;* Franklin, 1893, *Laybourne;* Middle Loupe, 1893, *Rydberg 1608;* Glenwood, 1888, *T. A. Williams.*

SOUTH DAKOTA: Black Hills, Fort Meade, 1887, *Forwood 15.*

OKLAHOMA: *Waugh 175.*

TEXAS: San Marcos, 1898, *Stanfield;* Crab Apple, *Jermey 471;* Industry, 1893, *Wurzlow.*

MINNESOTA: Fort Snelling, 1890, *Mearns 346, 347.*

ARKANSAS: Whippe Expedition, *Bigelow.*

Geum canadense Jacq. This has usually been known under the name *Geum album* J. F. Gmel. The latter was arbitrarily substituted by Gmelin, probably because he thought that it was more appropriate. I say arbitrarily and without good cause, for he simply based his species on Jacquin's plate and original description of *G. canadense.*

Geum album (i. e. *G. canadense*) has been reported from the valley of Mexico. As that station was so far remote from the otherwise known range of *Geum canadense*, the nearest station being in Texas, the writer thought that the specimens from Mexico belonged to some other species and that it was merely a case of misidentification. He found, however, in the National Herbarium three sheets collected by Schiede, *no. 580*, at San Angel, not far from Mexico City, and these specimens can not be distinguished from specimens from the United States. It was also collected at Chinantla, 1841, *Liebmann 1743.*

Geum Meyerianum Rydb. C. A. Meyer* gave a very good description of this species, but mistook it for *G. agrimonioides* Pursh, which is not a *Geum* at all, but *Drymocallis agrimonioides* (Pursh) Rydb., until lately usually known as *Potentilla arguta.* It was, therefore, necessary to give another name to *Geum agrimoni-*

* Ind. Sem. Petrop. 11: Supl. 29, 1846.

oides of Meyer and the writer with pleasure dedicated it to the botanist who first distinguished it. It is strange that this species (or variety) of the *Geum canadense* group has not been recognized by any American authors. It was admitted and described also by Scheutz in his monograph.* It is related to *G. canadense*, but the basal leaves and lower stem-leaves are pinnatifid and the stem is more hirsute. These characters are sometimes found in *G. hirsutum* Muhl. [*G. florum* (Porter) Bicknell], but the petals in *G. Meyerianum* are white and longer than the sepals, while in *G. hirsutum* they are pale yellow and much shorter.

The following specimens belong to *G. Meyerianum:*

NEW YORK: Fleishmann, Delaware County, 1892, *Hermann von Schrenk;* Tuxedo, 1896, *W. H. Lewis;* Oneida, 1903, *H. D. House.*

ONTARIO: Battersea, 1898, *Fowler.*

QUEBEC: Danville, 1894, *A. K. Berg.*

PENNSYLVANIA: New Danville, Pike Crossing, 1901, *Heller;* Bangor, 1899, *Porter;* Easton, 1899, *Porter.*

DISTRICT OF COLUMBIA: banks of canal, 1895, *Pollard.*

Geum hirsutum Muhl. This species has been well characterized by Porter and Bicknell under the names *G. album flavum* and *G. flavum*. It was also described by Fischer and Trautvetter, who mistook it for *G. canadense*, which they held distinct from *G. album*. The oldest name, however, is *G. hirsutum* Muhl. Muhlenberg listed it in his catalogue in 1813. In this publication it is to be regarded as a *nomen semi-nudum*, but nine years later Link gave it a short description, pointing out the essential characters.

Geum decurrens Rydb. Some specimens from New Mexico, Arizona and Colorado and named *G. strictum* seemed so different from all other specimens of that widespread and rather variable species, that the writer thought it advisable to propose in the North American Flora a new species based on these specimens The essential characters are pointed out in that work. It is, however, advisable to cite some more specimens.

ARIZONA: Bakers Butte, Mogollon Mountains, 1887, *Mearns 59.*

NEW MEXICO: Mogollon Mountains, 1903, *Metcalfe 536.*

COLORADO: Rico, 1898, *Crandall 4109.*

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* Nov. Act. Soc. Sci. Upsala III. 7: 32. 1870.

Geum oregonense (Scheutz) Rydb. This was originally described as a variety of *G. urbanum* to which it is not closely related. Its relationship is with *G. macrophyllum.* Usually it is well distinguished from that species by its open inflorescence, smaller stem-leaves and smaller and usually paler petals, but intermediate forms are not lacking. Some of these at least may be regarded as hybrids. *Geum oregonense* is common throughout the Rocky Mountains, as well as the Sierra Nevada and the Cascades. In the southern Rockies, *G. macrophyllum* is not found, but it extends east to northern New England, where *G. oregonense* is not found at all. In California the characters separating the two species seem to be less marked, and considerable questionable material has been seen.

Geum perincisus Rydb. Many subarctic specimens which might have been referred to *G. oregonense* have the upper leaves deeply incised and the petals broader and in form approaching those of *G. strictum.* It is hard to say whether these should be regarded as a variety of *G. oregonense* or as a distinct species. I adopted the latter view, because all these specimens were far northern ones and some of them found much further east than any of the typical *G. oregonense.* The following specimens belong here:

ALASKA: Eagle, Yukon Valley, 1902, *Arthur Collier 34, 35;* Copper River region, 1902, *William L. Poto 147.*

YUKON: Fort Selkirk, 1899, *Tarleton 120.*

MACKENZIE: Fort Simpson, 1861–62, *Onion, Kennicott & Hardisty;* Fort Resolution, 1901, *Preble & Preble 154.*

ALBERTA: Cave Avenue, Banff, *McCalla 2074.*

MICHIGAN: Turin, 1901, *Barlow.*

Geum strictum Ait. is a very variable species. Usually the terminal leaflet is more or less rhombic, as it is commonly described, but not seldom it is rounded or subreniform as it is in *G. macrophyllum* or *G. oregonense.* It usually can be easily distinguished by its large rounded petals and always by its fruit. The lower portion of the style is never glandular and the upper portion has hairs about twice as long as those of the other two species. *Geum scopulorum* is the common form of *G. strictum* in the Rockies, a little less robust than in the East.

Geum aleppicum Jacq.* has been regarded as a synonym of *G. strictum*. Being an older name it should have been substituted. But I think that it is well distinct from the North American plant. So are all specimens from Europe referred to *G. strictum*. Whether they should all be included or not in *G. aleppicum*, I could not tell, but it is evident that *G. strictum* should be excluded from the flora of Europe and Asia Minor.

Geum mexicanum Rydb. Specimens in habit much resembling *G. macrophyllum* have been collected in southern Mexico. They were also determined as that species. As *G. macrophyllum* has not been collected at any station nearer than Sierra Nevada in California, it is very improbable that that species should grow in southern Mexico. A closer examination of these specimens revealed that the petals and the fruit were essentially those of *G. strictum*. As the habit is quite different, a new species *G. mexicanum* was proposed and based upon these specimens. To this belong the following:

VERA CRUZ: Mount Orizaba, 1891, *Henry E. Seaton 251*.

HIDALGO: Sierra de Pachuca, 1901, *Rose & Hay 5563*; 1906, *Rose & Rose 11489*.

Geum urbanum L., a native of Europe and temperate Asia, has been introduced in this country and is well established at several places, especially at Cambridge, Massachusetts.

Geum geniculatum Michx. The type locality of this species was given as Canada. This must have been a mistake, for the plant is known only from the mountain slopes of North Carolina and eastern Tennessee.

Geum rivale L. This is a native of North America as well as Europe and Asia. Rafinesque thought that the American plant was different and redescribed it as *G. nutans* Raf. As there was an older *G. nutans*, Steudel proposed the name *G. Rafinesquianum* for the American plant, but this was unnecessary as that and the European one are identical.

HYBRIDS

Hybrids in *Geum* are not unknown in Europe; why should they be in America? *Geum intermedium* Ehrh., a hybrid of *G.*

* Coll. 1: 80.

rivale L. and *G. urbanum* L., has been known for a long time. *Geum rivale* L. hybridizes also here in America and the following hybrids have been known. As the flowers of *G. rivale* are quite different from those of most species of the genus, its hybrids are easily distinguished.

Geum rivale × *strictum*, *G. aurantiacum* Fries, was the first one to be recognized. It was described from garden material, but the following native specimens are to be referred here:

ALBERTA: *Macoun 20016*.

NEW YORK: Catskills, near Hunter, 1898, *Britton;* shores of Lake Champlain, 1900, *N. L. & E. G. Britton*.

Geum macrophyllum × *rivale*, *G. pulchrum* Fern., is represented by the following specimens:

VERMONT: Mendon, *Eggleston*.

QUEBEC: Bic, 1905, *Williams, Collins & Fernald*.

The hybrids between the species of the *G. strictum* group are not so easily distinguished, partly because the species themselves are closely related and seemingly grade into one another. As the intergrading forms are found in the region where the ranges of two species overlap, they may represent hybrids. As examples of such hybrids may be given the following specimens:

Geum oregonense × *strictum*.

UTAH: Logan, 1910, *George Zundel 206* (in part).

MONTANA: Helena, 1908, *Butler 798*.

COLORADO: Honnold, 1901, *Tweedy 4172*.

Geum macrophyllum × *oregonense*.

BRITISH COLUMBIA: Seagit Valley, 1905, *J. M. Macoun 69914*.

WYOMING: Crevasse Mountain, Yellowstone Park, 1902, *Mearns 2191*.

MONTANA: Tobacco Mountains, 1909, *Butler 4231*.

OREGON: Oregon City, 1905, *Lyon 60*.

Geum macrophyllum × *strictum*.

MONTANA: Lake McDonald, 1901, *MacDougal 959*.

SIEVERSIA

This genus was based on *Sieversia anemonoides* and hence monotypic. In 1823 Robert Brown extended the genus to include all the Geums without articulate styles. This limitation was retained up to 1906, when Dr. Greene segregated from it *Acomastylis* and *Erythrocoma*. In my opinion the former was rightly taken out, as it differs from *Sieversia* by the same character of the fruit that separates *Anemone* from *Pulsatilla*. *Erythrocoma* on the other hand I can not regard as distinct generically from *Sieversia*. Its species differ from the type of *Sieversia* only in the erect instead of spreading petals and a better developed hypanthium. If *Erythrocoma* should be kept distinct, *Geum rivale* should be taken out of *Geum*, as it differs by just the same characters, and still that species frequently hybridizes with the other species. Dr. Greene made the following statements which are not exactly true: "*Sieversia* was founded on a Siberian undershrub, low and slender, with almost rotate calyx and corolla, the former nearly chorisepalous, and its mature styles are long, filiform, plumose to the very apex." There are apparently three species which have gone under the name *Sieversia anemonoides*, of which one can be called an undershrub, the other two having the habit of *Dryas octopetala*, being strongly cespitose with the branches more or less covered by soil and moss. I think the type of *Sieversia* was one of these. The difference between this cespitose stem and the branching rootstock of *Erythrocoma* is indeed very small. The styles of *Sieversia anemonoides* Willd., or *S. pentapetala* (L.) Greene, are not plumose to the apex, for the upper part is naked, soft, withering, as it is in *Erythrocoma*, the only difference being that it is very short, scarcely 2 mm. long. This naked portion of the style is found not only in the type of *Sieversia* and in *S. ciliata* and its relatives, but also in the *S. montana* group, to which *S. radicata*, *S. Peckii* and *S. calthifolia* belong. The naked portion in most is rather persistent, although usually withering in age, but in some species or even individuals it breaks off. It is however never articulated to the lower portion of the style as in *Geum*, where the upper portion, which is usually hairy, falls off very early. C. P. Smith* describes the style of *Erythrocoma ciliata* as follows: "Style hooked, or *articulated* [italics mine], the terminal portion often deciduous." I have seen it somewhat bent or even occasionally hooked, but never with a proper articulation. The soft upper naked portion, after it has withered, often falls off at

* Muhlenbergia 8: 7. 1912.

the junctions with the hard persistent lower portion, but there is no marked articulation at this point as there is in *Geum*.

As to the limitation of the species, it is impossible for me to follow Dr. Greene in his segregation. The original two species of Pursh's *Geum triflorum* and *Geum ciliatum* are apparently well distinct; the intermediate forms may be hybrids. *Erythrocoma campanulata* Greene seems also to be a good species. In the North American Flora I also admitted *Sieversia grisea* (Greene) Rydb., *S. canescens* (Greene) Rydb., *S. flavula* (Greene) Rydb. and *S. brevifolia* (Greene) Rydb. If the first two really are specifically distinct from *S. triflora* (Pursh) R. Br. and the last two from *S. ciliata* (Pursh) G. Don is questionable. The other species of *Erythrocoma* of Greene are nothing but forms of those mentioned, due to local conditions.

Sieversia pentapetala (L.) Greene (*S. anemonoides* Willd.) is an Asiatic species reported for America only from the Aleutian Islands. The only specimens I have seen from this region were collected by Dall.

Sieversia glacialis (R. Br.) Spreng. This species has the floral characters of the genus *Erythrocoma* Greene, but the habit suggests the species of *Acomastylis*. Some of the specimens are as follows:

ALASKA: York Plateau, near Ip-muk, Port Clarence, 1901, *Walpole 1906;* Port Clarence, 1901, *Collier.*

SIBERIA: Whalen, 1894, *J. T. White.*

Sieversia campanulata (Greene) Rydb. is the best species of *Erythrocoma* described by Dr. Greene. The broad reddish petals much exceeding the obtusish sepals and bractlets. It seems to be confined to the Olympic Mountains. The following specimens belong here:

WASHINGTON: Olympic Mountains, *Elmer 2529; Wilkes Expedition 352, 813* in part.

Sieversia triflora (Pursh) R. Br. This is distinguished from *S. ciliata* (Pursh) G. Don in the broader, less deeply cleft leaflets and the more persistent style-tips, as pointed out by C. P. Smith, but there is another character which seems to have been overlooked. In all the other species referred to *Erythrocoma*, the hypanthium is rounded or even sunken at the base, even at flowering time, and the bractlets are not much, if any, exceeding the sepals in length; in *S. triflora* the hypanthium at least in anthesis is acute at the base and the bractlets much exceeding the sepals in length. If so characterized, *Sieverisa triflora* takes in all the forms growing on the prairies or plain region east of the Rockies and extending into Montana and Wyoming.

Erythrocoma cinerascens Greene and *E. affinis* Greene I can not distinguish from it. The former is a depauperate form, I take to be due to a higher altitude, represented by most specimens from the Black Hills and Wyoming. The latter is the high northern form with narrower leaflets and brighter coloration. If held distinct it had two older names than that of Dr. Greene, viz. *Sieversia rosea* Graham and *Geum Grahami* Steudel.

Sieversia grisea (Greene) Rydb. The following proposed species of *Erythrocoma*, viz. *E. grisea*, *E. arizonica*, *E. tridentata* and *E. aliena*, all by Greene, have many characters common with *S. triflora*, viz. the habit, leaf-form and toothing, pubescence, and styles, but the hypanthium is not acute at the base, the petals are broader and the bractlets shorter, slightly if at all longer than the sepals.

They were all described from Arizona and Chihuahua, but the same forms are common in Colorado and rarely as far north as Montana and Washington. They constitute the mountain representatives of *S. triflora*. Of these *Erythrocoma grisea* is the first one in the list. The type does not represent the common form, but is a depauperate form with short leaves, standing in the same relationship to the common form as *E. cinerascens* Greene stands to *Sieversia triflora*. The common better-developed form represents *E. arizonica* and is common in Colorado. *E. tridentata* is a form with looser pubescence and narrower leaflets, otherwise not distinguishable from *E. arizonica*. *E. aliena* is exactly the same as *E. grisea*.

Erythrocoma australis I regard as a hybrid between *Sieversia grisea* and *S. ciliata*. See my notes in the North American Flora.

Sieversia canescens (Greene) Rydb. The forms of *Erythrocoma* of the mountains of California, Oregon and Washington differ very little from *S. grisea*, as here understood, except in a denser pubescence and shorter bracts. It is doubtful if they should be regarded as a distinct species. I retained, although with hesitation, the specific rank of these forms, on which *Erythrocoma canescens* Greene was based.

Sieversia ciliata (Pursh) G. Don. This species is confined to the Rocky Mountains and running down into the Cascades of Washington. It is found neither on the plains nor in the Sierra Nevadas. In most of its range it is associated with *S. grisea* and intermediate forms are not lacking; they are perhaps to be explained as of hybrid origin. The center of its distribution is in the northern Rockies, while that of *S. grisea* is more common in the southern. Its range barely touches that of *S. triflora* and only slightly overlaps that of *S. canescens*.

Sieversia flavula (Greene) Rydb. It was only with reluctance I admitted this as a species in the North American Flora. It is rather local in the mountains of Wyoming and Montana. The following specimens have been seen.

WYOMING: *A. Nelson 829, 7501.*

MONTANA: *Chestnut & Jones 105; Rydberg & Bessey 4414.*

Sieversia brevifolia (Greene) Rydb. This is a derivative of *S. ciliata*. It is confined to the mountains of central Utah. *S. Watson 318*, doubtfully referred here by Dr. Greene, I think should be referred to *S. ciliata*. The following specimens belong here:

UTAH: Panguitch Lake, *Jones 6002g;* Fish Lake, *Jones 5779g, 5441o; L. F. Ward 378.*

Sieversia Peckii (Pursh) R. Br. This and the three following form a distinct natural group, which is represented in Europe by *Sieversia montana* and other species. *S. Peckii* has been confused with *S. radiatum* or has been made a variety of the same. It is, however, perfectly distinct. It is confined to the mountains of New Hampshire and Maine.

Sieversia radiata (Michx.) R. Br. This is closely related to the northwestern *S. calthifolia* (Menzies) D. Don. It is confined to the region of which Roan Mountain is the center, and the majority of the specimens in our herbaria are from that very mountain.

Sieversia calthifolia (Menzies) D. Don. This species is rather variable. In the high arctic regions it becomes stunted and more hairy (var. *congesta*), and then has a quite different appearance. Another cause for the many synonyms cited under the species has been the supposition that there are two species in the northwest represented by *Geum calthifolium* Menzies and *Geum rotundifolium* Langsd. It is evident that *G. calthifolium* Menzies described in Rees' Cyclopedia was based on the plant known as *Geum rotundifolium.* Scheutz seemed to be of a different opinion. He kept *Geum rotundifolium* and *G. calthifolium* distinct. His description of the latter (which by the way does not agree with that in Rees' Cyclopedia) seems, however, to be drawn from specimens of *S. macrantha* Kearney or some related species and not from *S. calthifolia.*

Sieversia macrantha Kearney. This species was distinguished by Kearney and his description was found in the manuscript of the Flora of Alaska, which has been in preparation for many years by the botanists of the United States Department of Agriculture. As there was no telling when this work would be published, I adopted Kearney's name and description, with such slight modifications in form as to make it congruous with the general style used in the North American Flora. I have seen no specimens except those of the type collection. It may be possible that Scheutz drew his characterization of *G. calthifolium* from specimens of this species.

ACOMASTYLIS

As stated before, the writer agrees with Dr. Greene that the specimens referred to it should be removed from *Sieversia* as well as from *Geum.* They are closely related and the distinguishing characters are rather trivial, but as these trivial characters are supported by different ranges, the writer thinks they are of specific value.

Acomastylis humilis (R. Br.) Rydb. and *A. Rossii* (R. Br.) Greene. The former seems sometimes to grade into the latter, but as its range is much more limited than that of *A. Rossii*, it is at least a geographical species. It is confined in America to the Aleutian and Pribiloff Islands, but is also found in eastern Siberia, while *A. Rossii* extends well into Arctic America as far east as Melville Island.

Acomastylis gracilipes (Piper) Greene and *A. depressa* Greene are only known from the type collections. They are closely related to *A. sericea*, but the hypanthium is more flat, not turbinate as i is in *A. sericea* and *A. turbinata*. *A. gracilipes* was first described as a *Potentilla*. In this respect it has had the same fate as *A. turbinata*.

Acomastylis sericea Greene has a more western and northern distribution than *A. turbinata* (Rydb.) Greene. The following specimens have been seen.

Nevada: Ruby Mountains, *Heller 9139, 9359;* East Humbolt Mountains, *Watson 320;* same locality, *M. E. Jones 1897*.

Idaho: Salmon River Mountains, *Henderson 4035*.

Montana: Indian Creek and Pony, *Rydberg & Bessey 4416, 4417;* Spanish Peaks, *Flodman 608;* Belt Mountains, *Scribner 40;* Rone Mountain, *Chestnut 9*.

Wyoming: Wind River Mountains, *V. Bailey;* northwestern Wyoming, *Rose 290*.

Acomastylis turbinata (Rydb.) Greene. The range of this species covers that of the preceding, but includes also Colorado, Utah, Arizona and New Mexico.

COWANIA

Cowania mexicana D. Don is not found within the United States, and not even near the boundary. It is confined to central Mexico. The plant of southwestern United States and northern Mexico should be known as *C. Stansburiana* Torr., which differs in the form of the hypanthium and the lobing of the leaves. *C. mexicana* is represented by the following specimens:

Mexico: Durango, 1896, *Palmer 12, 71; Nelson 4696;* Sierra Madre, *Seeman; Hartweg*.

Cowania Davidsonii Rydb. is closely related to *C. Stansburiana*, but differs in the elongated pedicels, the form of the hypanthium, etc. The following specimens belong to it:

Arizona: Blue River, September 8, 1902, *A. Davidson 754;* Castle Creek, Bradstran Mountains, 1892, *Toumey 129d*.

Cowania alba Goodding is unknown to me, except as to a poor fragment collected by Purpus and as to the descriptions. Purpus' specimens may well represent a hybrid of *C. Stansburiana* and *Kuntzia tridentata*.

Cowania ericaefolia Torr. and *C. Howardi* S. Wats. are the same. The writer has seen the types of the two, which are identical, but no other specimens. The species must be very local.

FALLUGIA

Three species have been proposed in this genus, viz. *F. paradoxa* (D. Don) Endl., *F. acuminata* Cockerell and *F. micrantha* Cockerell. Besides, the first has had two additional specific names, viz. *Geum cercocarpoides* DC. and *Fallugia mexicana* Walp. It has been impossible for the writer to distinguish more than one species, for the lobing or not lobing of the sepals is very inconstant, the same individual having both lobed and unlobed sepals, and the size of the petals is so variable, that no line can be drawn between *F. acuminata* and *F. micrantha*. In the essentially staminate plant the petals are usually larger.

KUNTZIA vs. PURSHIA

Dr. Greene,* when adopting the name *Kuntzia* instead of *Purshia*, made the following remarks: "A well-known rosaceous type of Rocky Mountain and Californian shrub, at first referred to the South American genus *Tigarea*, was taken up by the elder De Candolle in 1818, as a new genus, under the name *Purshia*. Sprengel, who about a year earlier, had himself published a genus *Purshia*, soon after proposed *Kuntzia* for the name of the Candollean *Purshia;* and this will apparently be the proper name for the western genus now called *Purshia*, which latter name is more than once revertible; for Rafinesque had a *Purshia* in print as early as 1813. I find no record of any earlier *Kuntzia* than this of Sprengel, which most writers who have mentioned it, say was substituted for the Candollean *Purshia* in Sprengel's Systema, 1825; but I find it four years earlier than that, in the first edition of Steudel's Nomenclator (1821)."

There is more than one correction to be made in the above statement. *Purshia* DC. was not published in 1818. The publication is usually cited as *Purshia* DC., Trans. Linn. Soc. Bot. **12**: 157. 1818. The title page of that volume bears the year 1818, but the first part of it, in which *Purshia* appears, was published in 1817. The first publication of *Purshia* Sprengel was neither in his Systema (1825), nor in Steudel's Nomenclator, but in

* Pittonia **2**: 298. 1892.

Sprengel's Anleitungen,* 1817. Then comes the question which was the earlier, *Purshia* DC. or *Purshia* Spreng. Fortunately, Sprengel himself when proposing *Kuntzia* gave under *Purshia* DC., which he replaces, a reference to the Supplement to Lamarck's Encyclopedie Methodique,† where Poiret publishes *Purshia* for De Candolle, the year before its technical publication by De Candolle in the Transactions of the Linnean Society. There is, therefore, no question concerning *Purshia* DC. antedating *Purshia* Spreng. But how about *Purshia* Raf.? I have been unable to find it mentioned in any of Rafinesque's writings of 1813. The Kew Index gives the publication of *Purshia* Raf. as "Am. Month. Mag. (1819) 191." At the place referred to we find only the following remarks under *Onosmodium:* "Sprengel has since given it the name *Purshia*, which had already been applied to another genus." Nobody can tell if this refers to an earlier *Purshia* Raf. It may just as well refer to the earlier *Purshia* DC. Apparently the first appearance of *Purshia* Raf. was in Journal de Physique‡ in 1819. It is evident that *Purshia* DC. can not be thrown out on any other ground than by regarding *Burshia* Raf. (1808) an error in orthography. It was not a misprint, for Rafinesque states that it was named after Mr. Bursh and on the unpublished plate of Rafinesque's, the original spelling is *Burshia*.

CHAMAEBATIA

Chamaebatia australis (Brand.) Abrams has been collected in Lower California by Orcutt and Miss Irish and in southern California by Pringle in 1882 and by Chandler, *no. 5214*.

CERCOCARPUS

Cercocarpus macrophyllus C. K. Schneider is the most common of the Mexican species of *Cercocarpus*. Most of the material labeled as *C. fothergilloides* belongs to this species. Some of the specimens are cited below.

VERA CRUZ: Orizaba, 1892, *J. G. Smith 199;* Cuerta de San Juan del Estada, *Liebman 1719*.

HIDALGO: Pachuca, 1905, *Purpus 1139*.

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* Ed. 2, 2: 450. 1817.

† v. 4: 623. 1816.

‡ 89: 257. 1819.

JALISCO: *Leon Dequet.*

OAXACA: 1894, *Pringle 5871.*

GUERRERO: Chipancingo, 1903, *Nelson 7068;* between Chilapa and Texla, 1894, *Nelson 2168.*

Cercocarpus fothergilloides HBK. To this species the following are to be referred.

PUEBLA: Cerro de Paxtle, *Purpus 4200.*

VERA CRUZ: Orizaba, *F. Mueller.*

Cercocarpus Traskiae Eastw. has not been collected outside of Santa Catalina Island, California.

Cercocarpus mojadensis C. K. Schneider. To this belongs the following specimens:

COAHUILA: Sierra Mojada, 1892, *M. E. Jones 134;* Sierra de Plata, 1905, *Purpus 1059;* San Lorenzo Canyon, 1905, *Palmer 537.*

Cercocarpus Pringlei (C. K. Schneider) Rydb. This was originally described as a variety of *C. mojadensis*, but I think it is specifically distinct.

Cercocarpus macrurus Rydb. This is the *C. parvifolius* of the Klamath and Siskiyou region of California and Oregon. It is nearest related to *C. montanus* Raf., differing in the longer leaves with more numerous lateral veins and the large fruit. Although the characters separating it from *C. montanus* on one hand and *C. Douglasii* on the other are not so striking, it is geographically separated from both, the former being limited to the Rockies and the latter to central and southern California. The following specimens belong to it:

CALIFORNIA: Siskiyou Mountains, 1880, *Engelmann* (fruit); same locality, 1866, *Henderson* (flowers); Ashland, 1866, *Henderson 259* (flowers and young fruit); Klamath River at Keno, *Cusick 2835;* Klamathon, 1903, *Copeland 3504;* no locality, *Wilkes Expedition 1167.*

OREGON: Weiner, 1898, *Walpole 81;* Barclay Springs, Modoc Point, *Coville 1523* in part.

Cercocarpus montanus Raf. There have been two species confused under the name of *C. parvifolius* Nutt. even from its first description in the Botany of Beechey's Voyage by Hooker & Arnott. These authors adopted Nuttall's manuscript name, but included in their description not only Nuttall's type from the Rockies but also specimens collected by Douglas in California. The latter were the base of the description and figure in Hooker's Icones, *plate 323*. It is a question whether Hooker & Arnott did not have Douglas's specimens in mind when they drew the description of *C. parvifolius*. It would, therefore, be some doubt as to which the name *C. parvifolius* should be applied, the low shrub of the Rocky Mountains or the more tree-like one from southern and central California. Sargent referred both to *C. parvifolius*, while C. K. Schneider, who without question has done the best and most critical work on the genus, referred the latter to *C. betulaefolius*, yes, even made it the "var. *typicus*" of that species. Schneider laid more stress on the form and size of the teeth of the leaves and in this respect Douglas's plant is more like *C. betuloides*. If the pubescence and leaf-form are considered, it resembles more the plant of the Rockies. As said before, it is doubtful which of the two should be regarded as *C. parvifolius*. As Nuttall's plant is included in the original description it must be regarded as the type, but unfortunately, or rather fortunately, it (i. e. the Rocky Mountain shrub) had already a name, *C. montanus* Raf., based on *C. fothergilloides* Torrey, not that of Humboldt, Bonpland and Kunth; and *C. parvifolius* becomes a synonym. Hence the more tree-like species of California, represented by Douglas's specimens, was left without a name, and the writer proposed the name *C. Douglasii* in the North American Flora.

Cercocarpus Douglasii Rydb. See the discussion above. Of this species I have seen many specimens. They are all from California, except the following:

ARIZONA: Jucumba Hot Springs, 1894, *Schoenfeldt 335*.

LOWER CALIFORNIA: Nachaguere Valley, 1894, *Schoenfeldt 3432* and *Mearns 3390*.

Cercocarpus rotundifolius Rydb. This is related to the preceding species, but differs in the small broad rounded-oval leaves; in *C. Douglasii* the leaves are obovate or oblanceolate, distinctly cuneate at the base. To *C. rotundifolius* belongs the following specimens:

CALIFORNIA: Los Angeles County, 1901, *Grant 3488;* 1850, *C. C. Parry;* 1890, *H. E. Hasse.*

LOWER CALIFORNIA: mountains, 1882, *Pringle.*

Cercocarpus alnifolius Rydb. This is the same as *C. betulaefolius Blancheae* of C. K. Schneider, mainly; although that author had included some specimens of *C. Douglasii* mixed in with the type. As a species had already been named after Mrs. Blanche Trask, viz. *C. Traskiae*, it would be bad taste to propose another one. Besides personally I dislike the use of the given name of a person as forming the specific name. I, therefore, adopted the more appropriate *C. alnifolius* instead of the varietal name *Blancheae*. This species is also endemic to Santa Catalina Island, California.

Cercocarpus betuloides Nutt. Hooker in his Icones changed the name to *C. betulaefolius*, which form has been more commonly adopted than the original. It has also been regarded as a variety of *C. parvifolius* Nutt., i. e. of *C. montanus* Raf., but is evidently distinct.

Cercocarpus minutiflorus Abrams. Nothing further has been added to the knowledge of this species since its publication.

Cercocarpus flabellifolius Rydb. In Utah and northwestern New Mexico is found a mountain mahogany, having the pubescence of the Californian *C. betuloides* and the coarse toothing of the leaves of *C. montanus*. It has obovate leaves as the latter, but much broader and with more flaring teeth. This character is best seen in the type collected by L. F. Ward. The following specimens are to be referred here:

UTAH: Glenwood, 1875, *Ward 122;* western slope of La Sal Mountains, 1911, *Rydberg & Garrett 8566;* south side of Abajo Mountains, *9275;* Juab, 1902, *Goodding 1073;* Silver Reef, 1894, *Jones 5163, 5163b;* Laccolite, *Jones 5663, 5204e;* Marysvale, *Jones 5405d;* Cedar City, *Jones 5208, 5404d;* Salina Canyon, *Jones 5441m;* Fish Creek Canyon, 1909, *Garrett 2523.*

NEW MEXICO: Aztec, 1899, *Baker 384.*

Cercocarpus argenteus Rydb. This is related to *C. montanus*, but the pubescence is appressed-silky, the leaves narrower, toothed above the middle with smaller teeth. The following specimens belong here:

TEXAS: Randall County, *Eggers;* Llano Estacado, *Bigelow* (Whipple Exp.); Guadalupe Mountains, 1901, *Bailey 436.*

NEW MEXICO: El Capitan Mountains, 1900, *Earle 209;* same locality, *Plummer;* Winsor's Ranch, 1908, *Standley 4104;* Ratan Mountains, 1903, *Griffiths 5497;* White Mountains, 1907, *Wooton & Standley 3606;* Sacramento Mountains, 1899, *Wooton;* Las Vegas, 1891, *Dewey;* Folsom, 1903, *A. Howell 171.*

COLORADO: North Cheyenne Canyon, 1894, *E. A. Bessey.*

Cercocarpus paucidentatus (S. Wats.) Britton. This species was based on *Cercocarpus parvifolius paucidentatus* S. Wats. In order to determine the type of the species, we must find the type of the variety. The latter was based on *Shaffner 114, Parry & Palmer 224** from San Louis Potosi, and *Wright 1056* from Texas or eastern New Mexico. The first, *Shaffner 114*, must be regarded as the type, but *Parry & Palmer 225* is the same. Upon this very number C. K. Schneider based his *C. Treleasii*, which therefore becomes a synonym. *Wright 1056* belongs to another species, the same as Wilcox's specimen from which Britton mainly drew his description of *C. paucidentatus.* This was without a specific name, and I adopted Schneider's varietal name for it. The following specimens belong to *C. paucidentatus* (S. Wats.) Britton or *C. Treleasii* C. K. Schneider.

SAN LOUIS POTOSI: *Shaffner 114, 476, 635; Parry & Palmer 225.*

HIDALGO: Ixmiguelpan, 1905, *Purpus 1383.*

Cercocarpus eximius (C. K. Schneider) Rydb. This is *C. paucidentatus* Britton, mainly as to the description, but not the type. Sargent regarded it as the same as *C. brevifolius* A. Gray. Schneider first admitted it as a variety *eximius*, but afterwards adopted Sargent's views. He, however, did not have a clear conception of the same, for *Rusby 125* and other specimens with better developed and more toothed leaves, he referred doubtfully to *C. betulaefolius.* Leaves toothed above the middle are not uncommon and sometimes found together with perfectly entire-margined leaves on the same bush. It is to be admitted that it is closely related to *C. breviflorus*, but differs in the spreading pubescence and the longer hypanthium. It is also much more common than *C. brevifolius* and its range extends through New Mexico, Arizona, Chihuahua and Sonora.

* This is evidently a misprint for 225, because *Parry & Palmer 224* is a species of *Rubus* and also cited by Watson under *Rubus trivialis.* It is now known as *R. oligospermus* Thornber.

Cercocarpus breviflorus A. Gray. This has nearly the same range as the preceding, but is more eastern, being found also in western Texas and Coahuila. It is, however, lacking in Sonora and western Arizona.

Cercocarpus ledifolius Nutt. is the most widely distributed species of the genus. Its characters are rather constant. It varies, however, in the width of the leaves and in the margin being more or less revolute. *Cercocarpus ledifolius intercedens subglabra* C. K. Schneider is either an extremely narrow-leaved form or else a hybrid with *C. intricatus*.

Cercocarpus hypoleucus Rydb. This has been mistaken for both *C. ledifolius* and *C. intricatus*, but the villous pubescence of the lower surface of the leaves should exclude it from either, though it may cause some confusion with *C. arizonicus*. It has smaller, narrower leaves with sharper petioles than *C. ledifolius*, but larger leaves, less enrolled, and larger fruit than *C. intricatus* and *C. arizonicus*. The following specimens are referred here:

MONTANA: Melrose, 1895, *Rydberg 2695; Shear 3216;* Red Rock, *Shear 3349;* Helena, 1908, *Butler 713, 774;* Tobacco Mountain, *Butler 4236;* Montana, *Kelsey;* Lombard, 1900, *Blankinship.*

WYOMING: Wolf Creek Canyon, *A. Nelson 2292;* between Sheridan and Buffalo, 1900, *Tweedy 3236;* Big Horn, 1899, *Tweedy 2540;* Powder River, 1901, *Goodding 252;* 1893, *Evermann;* Big Horn Basin, 1893, *V. Bailey;* Tongue River, 1898, *Tweedy 39.*

IDAHO: Salmon River, *Henderson 3143* and *3790; V. Bailey 49.*

UTAH: Raft River, *S. Watson 313* in part.

OREGON: Snake River, 1897, *Sheldon 8201.*

Cercocarpus intricatus S. Wats. M. E. Jones reduced this to a variety of *C. ledifolius*, claiming that they grade into each other; and still he proposed a new species *C. arizonicus*, which is much closer to *C. intricatus* than *C. ledifolius* is. I have seen the specimens from Willow Spring, Arizona, on which *C. arizonicus* was based and these are identical with Jones's own specimens from Deep Creek, determined by Jones as *C. ledifolius intricatus*. It is evident that Jones did not distinguish these species very well. Some of Jones's specimens are evidently hybrids. See below. The range of *C. intricatus* includes parts of Utah, Arizona and Nevada. A specimen from California, but with much shorter leaves, scarcely 5 mm. long, is referred doubtfully to this species. It is *Vernon Bailey 2019* of the Death Valley expedition.

Cercocarpus arizonicus Jones. This species is much more local than *C. intricatus*. It is closely related to it, perhaps not distinct If *C. hypoleucus* were found in the region this might be a hybrid between that species and *C. intricatus*.

UTAH: Deep Creek, 1891, *M. E. Jones;* Tropic, 1894, *Jones*.

NEVADA: Rock Mountains, 1898, *Purpus 6336?*.

HYBRIDS

Mr. Coville has collected specimens which are without doubt a hybrid between *C. ledifolius* and *C. macrurus*. A specimen of the hybrid and one of each of the two parents is mounted on the same sheet, his *no. 1523* in the National Herbarium. When these two species hybridize, it would be expected that some of the more closely related species might do so. This may explain some of the intermediate forms between *C. betuloides* and *C. Douglasii*, between *C. montanus* and *C. flabellifolius*, and between *C. ledifolius* and *C. intricatus*.

Also a specimen collected by M. E. Jones at Silver Reef in 1894 seems to be a hybrid of *C. ledifolius* and *C. arizonicus*. A specimen of the latter is included under the same number, *5149k*, and *C. ledifolius* is found in the region.

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WEST INDIAN MOSSES—II

MOSSES OF THE DANISH WEST INDIES AND VIRGIN ISLANDS

ELIZABETH GERTRUDE BRITTON

NEW YORK
1915

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West Indian mosses—II. Mosses of the Danish West Indies and Virgin Islands

ELIZABETH GERTRUDE BRITTON

(WITH PLATE 1)

In February, 1913, Miss Delia W. Marble and I spent four weeks collecting on the island of St. Thomas, while Dr. Britton and Dr. Shafer cruised around among the other islands of the Archipelago in search of cacti and other plants. An account of their trip will be found in the Journal of the New York Botanical Garden.*

As far as we know, no record of any other collection of mosses from these islands exists, excepting the brief account given by Dr. I. Urban† of the collections made by the Rev. Johann Christian Breutel in 1841. Most of Breutel's mosses, 310 numbers, are deposited at the British Museum, but his collections included specimens from St. Thomas, St. Croix, St. Jan, St. Kitts, and Antigua, as well as the collections made in South Africa in 1853–1854. This would account for the large number of specimens preserved in his herbarium, as our experience has shown that the Danish and Virgin Islands are not particularly rich in species of bryophytes.

William Mitten had a few duplicates from Breutel's collections including the following six species: *Calymperes Richardi* C. Müll. (distributed as *C. Afzelii* Sw.), *Hymenostomum Breutelii* (C. Müll.) Broth., *Tortula agraria* (Sw.) Sw., *Philonotis tenella* (C.

* Jour. N. Y. Bot. Garden **14**: 99. 1913.

† Symbolae Antill. **3**: 28. 1902.

Müll.) Jaeg., *Stereophyllum leucostegum* (Brid.) Mitt. (distributed as *Hypnum Breutelii* Schimp.), and *Taxithelium planum* (Brid.) Mitt. (distributed as *Hypnum Antillarum* Schimp. ms.).

Baron von Eggers collected a few mosses in St. Thomas, St. Jan, and Tortola in 1887, but as far as we know no list of these has been published.

We collected about seventy packets, but found only twenty-eight species, representing twenty-two genera, though we added three new species, a small *Phascum*, a sterile *Hyophila*, and a sterile *Bryum*, which has since been found on Mona Island also.

A brief synonymy with localities and habitat of these species is given in the following enumeration: Nos. 1–4 and 7–9 were determined by Mr. R. S. Williams; Nos. 16 and 17 by M. G. Dismier. Unless otherwise noted the specimens cited were collected by Miss Marble and myself.

1. DICRANELLA LONGIROSTRIS (Schwaegr.) Mitt. Jour. Linn. Soc. Bot. **12**: 30. 1869

ST. JAN: without definite locality, *Breutel*, 1841.

2. LEUCOLOMA SERRULATUM Brid. Bryol. Univ. **2**: 752. 1827

Leucoloma Riedlei Besch. Jour. de Bot. **5**: 146. 1891.

ST. THOMAS: on trees in wet woods, *Riedlé*.

3. OCTOBLEPHARUM ALBIDUM (L.) Hedw. Descr. **3**: 15. 1791

ST. THOMAS: on roots of an *Anthurium*, stone walls, between Pearl and Bonne Resolution near Caret Bay, *1337*.

4. LEUCOBRYUM POLAKOWSKYI (C. Müll.) Cardot, Mém. Soc. Sci. Nat. Cherbourg **32**: 82. 1900

TORTOLA: on rotten wood, Sage Mt., *W. C. Fishlock 83*, May, 1913. Also in Porto Rico, *E. G. Britton 2518*, April, 1913.*

5. FISSIDENS KEGELIANUS C. Müll. Linnaea **21**: 181. 1848

ST. THOMAS and ST. JAN: at base of palms and on the ground, *Breutel*, 1841 (distributed as *F. palmatus* [Sw.] Hedw.). ST. JAN: wet bank, Bethania, *Britton & Shafer 208a*. ST. THOMAS:

* Both these are additions to ranges since the publication of Part 2, Vol. 15, of North American Flora.

moist banks near French wharf; Water Island, Cowell Point, *147;* St. Peter, *38*, *98;* Magin's Bay, *191;* Smith's Bay, *1289*, *1316*, *1459*.

6. FISSIDENS ELEGANS Brid. Spec. Musc. 167. 1806

ST. JAN; on wet rock, Bethania, *Britton & Shafer 361*. ST. THOMAS: Cowell Point, *100*.

7. SYRRHOPODON FLAVESCENS C. Müll. Syn. **1**: 541. 1849

ST. JAN: on rotten wood, Bordeaux, 300 m. alt., *Britton & Shafer 549*. TORTOLA: without definite locality, *W. C. Fishlock 82*. May, 1913.

8. CALYMPERES RICHARDI C. Müll. Syn. **1**: 524. 1849

Calymperes Breutelii Besch. Ann. Sci. Nat. Bot. VIII. **1**: 278. 1895.

Calymperes hexagonum Besch. l. c. 286.

Calymperes Hookeri Besch. l. c. 287.

ST. THOMAS: without definite locality, *Breutel* (type of *C. Breutelii*); without definite locality, *L. C. Richard* (type of *C. hexagonum*); on rocks, summit of ridge, by roadside, north of Charlotte Amalia, *408;* on bank, Cowell Point, *101*. TORTOLA: Roadtown to High Bush, 325 m. alt., *Britton & Shafer 772*.

9. CALYMPERES LONCHOPHYLLUM Schwaegr. Suppl. $\mathbf{1}^2$: 133. *pl. 98*. 1816

TORTOLA: Sage Mt., *W. C. Fishlock 85a*, May, 1913.

10. HYMENOSTOMUM BREUTELII (C. Müll.) Broth.; E. & P. Nat. Pfl. $\mathbf{1}^3$: 386. 1902

Weisia Breutelii C. Müll. Syn. **1**: 664. 1849. Not Schimp.

Gymnostomum Breutelii Br. & Sch.; Paris, Index Bryol. 542. 1895.

Weisia senocarpa C. Müll. Syn. **2**: 633. 1851.

Gymnostomum senocarpum Jaeger, Adumb. **1**: 280. 1873.

Hymenostomum senocarpum Paris, Index Bryol. 597. 1895.

Weisia Pabstiana C. Müll. Bot. Zeit. **15**: 382. 1857.

Weisia edentula Sull. Proc. Am. Acad. **5**: 273. 1861. Not Mitt.

Hymenostomum cubense Hampe; Paris, Index Bryol. Suppl. 189. 1900.

ST. JAN: Emaus, *Breutel* (type locality); wet banks, Bethania, *Britton & Shafer 209;* Rosenberg and Bordeaux, *Britton & Shafer 288, 534, 569.* ST. THOMAS: on the ground, Water Island, *155;* roadside banks, summit of ridge, Bonne Resolution, *1336;* Bordeaux, *1384;* St. Peter, *1258;* top of Flag Hill, *Fitch & Shafer 1494.* TORTOLA: Peter Island, *Britton & Shafer 860.* ANAGADA: without definite locality, *Britton & Shafer 1039*

11. **Hyophila uliginosa** E. G. Britton sp. nov.

Plants attached to rocks in stream, gregarious and matted together by fresh water algae, soft and flaccid when moist; stems simple, about 5 mm. high, branching at apex; leaves much discolored and clogged with mud at base, green and spreading at summit of stems, about 1 mm. long; base hyaline and oblong; apex lingulate and slightly carinate, apiculate; margins plane, entire or rarely denticulate with a few hyaline teeth at apex; costa stout, papillose on back and smooth above ending in the cuspidate point, in section showing one row of ducts and two small bands of stereid cells; basal cells hyaline, oblong or square, up to 16 μ long by 8 μ wide, upper cells obscure up to 5 μ in diameter, green and densely papillose, with several minute papillae on each surface; dioicous; flowers and fruit unknown; propagating by septate gemmae borne in clusters on brown filaments in the axils of the leaves. [PLATE 1, FIG. 1–6.]

TYPE LOCALITY:—ST. JAN: Bethania, *Britton & Shafer 367.*

12. **Phascum sessile** E. G. Britton sp. nov.

Plants annual(?), gregarious in loose bare earth, on banks; stems simple, or branching at base, with several rosettes from one root, 1–2 mm. high; leaves inrolled with conspicuous yellowish-white costa when dry, bright green in color and spreading when moist, few, 8–12, oblong at base, obovate above, 1–1.25 mm. long by 0.4–0.5 mm. wide; costa percurrent or excurrent into a short cuspidate point, terete and smooth on back, with a narrow dorsal stereid band and 2–3 rows of large ducts; margins entire or finely crenulate and papillose; upper cells hexagonal, up to 13 μ in diameter, densely chlorophyllose with 1–3 papillae on each surface; lower cells hyaline, oblong, 10–12 rows, up to 40 μ long, not papillose, occasionally curved and yellow and slightly auriculate at basal angles; paroicous, antheridia few, with paraphyses, in small buds below or near the archegonia, of which occasionally several are fertilized making 2–3 fruits on one plant; calyptra small, conic, split, slightly papillose at apex; capsule immersed, sessile on a small brown vaginule, globose, 0.5 mm. in diameter, sharply apiculate, indehiscent; walls with irregular hexagonal cells, 27–32 μ in diameter; spores brown, slightly roughened, 27–30 μ in diameter, maturing in spring. [PLATE 1, FIG. 7–13.]

TYPE LOCALITY:—ST. THOMAS: Cowell Point, *E. G. Britton 99*, February 2, 1913.

DISTRIBUTION:—ST. THOMAS: Water Island, *150*, *156*.

This species belongs to the section *Microbryum* and is close to *P. Floerkeanum*, but differs in the less acuminate and less subulate leaves with plane margins without a yellow border, and more chlorophyllose and papillose cells.

13. TORTULA AGRARIA (Sw.) Sw. Fl. Ind. Occ. 3: 1763. 1806

ST. JAN: Bethania, *Breutel;* Bethania, *Britton & Shafer 241*, *268*. ST. THOMAS: on limestone walls of old cemeteries, *Breutel;* on damp earth, Nisky, *77;* Cowell Point, *97;* old walls, Crown Estate, 450 m. alt., *1369;* on rocks at waterfall, Magen's Bay, *1315;* stone walls, Bonne Resolution School, *442*.

14. **Bryum micro-decurrens** E. G. Britton sp. nov.

Plants gregarious, in loose soil, brown at base and also more or less brown above, from the excurrent awns; stems dull green, slender, erect and mostly simple, unbranched, not more than 5 mm. high, matted with brown tomentum at base; leaves erect-appressed when dry, not twisted nor glossy; spreading when moist, less than 1 mm. long by 0.2 mm. wide; costa wide at base 40 μ (at least .2 width of leaf), excurrent into a short subulate brown awn, slightly toothed at apex and on awn; cells of blade hexagonal, 27–40 μ long $\times$ 10 μ wide, basal cells shorter, oblong, *with a long, decurrent narrow wing of one row of cells, extending down the stem to the next leaf;* margins bordered by one row of longer narrow cells 5 $\mu \times 54 \mu$ long, slightly revolute below and serrulate above; only known from sterile specimens.

TYPE LOCALITY:—ANAGADA: rocky plain near settlement, *Britton & Shafer 1038*.

DISTRIBUTION:—Mona Island, *Britton & Hess 1751*, *1753*.

These specimens have been compared with type specimens of *B. decursivum* C. Müll. from Porto Rico, kindly loaned to us by Dr. Engler from the Royal Botanical Garden at Berlin, and, though closely related by the decurrent narrow basal wing, ours differs in its shorter leaves, serrate margins and shorter cells.

15. BRYUM CRUEGERI Hampe; C. Müll. Syn. **1**: 300. 1849

Dioicous plants bright yellowish green, shining gregarious in loose soil in gravelly bed of stream; stems short, less than 1 cm. high, upper part of stem erect, base decumbent red and radiculose; leaves light yellowish green, glossy, spreading, lanceolate, acute or acuminate, 2 mm. long × 0.35–0.5 mm. broad; costa narrow, ending in the carinate, mucronate apex, margins entire below slightly serrulate at apex, not bordered nor revolute; cells hexagonal 54–108 μ long × 13 μ broad, a few alar, shorter and broader, square or oblong, not decurrent; sterile but often propagating by gemmae.

ST. THOMAS: in bed of stream at Tutu, *422*.

Compared with *Chas. Wright 63* from Cuba, distributed as *B. ovalifolium* Sull., the leaves are slightly narrower and less concave, but they are evidently closely related species and both belong with the group of tropical American species having glossy leaves, and flaccid red stems, resembling a *Pohlia*. They grow mostly along streams and form a closely related group, of which *B. ripense* C. Müll. from Jamaica is also a member.

16. PHILONOTIS SPHAEROCARPA (Sw.) Brid. Bryol. Univ. **2**: 25. 1827

ST. THOMAS: moist banks, Bonne Resolution *421;* Crown Estate, 450 m. alt., *1368*, *1458*.

17. PHILONOTIS TENELLA (C. Müll.) Jaeger, Adumb. **1**: 541. 1873–1874

ST. JAN: on wet banks, near Corallenburg, *Breutel*, 1841; Bethania, *Britton & Shafer 208*. TORTOLA: near Roadtown, 325 m. alt., *Britton & Shafer 773*.

18. PIREELLA CYMBIFOLIA (Sull.) Cardot, Rev. Bryol. **40**: 17. 1913

ST. JAN: on wet rock near Bethania, *Britton & Shafer 359*.

19. PTEROBRYUM ANGUSTIFOLIUM (C. Müll.) Mitt. Jour. Linn. Soc. Bot. **12**: 426. 1869

TORTOLA: High Bush, *Eggers 3240a*, December, 1887; Sage Mt., *W. C. Fishlock 85*, May, 1913.

20. NECKERA DISTICHA (Sw.) Hedw. Descr. **3**: 53. 1792

ST. THOMAS: on rocks at St. Peter, *1456*. TORTOLA: on rock in forest, High Bush, 375 meters alt., *Britton & Shafer 841*.

21. NECKERA JAMAICENSE (Gmel.) E. G. Britton, Bull. Torrey Club **40**: 656. 1913

ST. JAN: on bark of trees at Bethania, *Britton & Shafer 364*.

22. CALLICOSTELLA BELANGERIANA (Besch.) Jaeger, Adumb. **2**: 257. 1874–1875

ST. JAN: on stones, Bordeaux, 300 meters alt., *Britton & Shafer 548*.

23. STEREOPHYLLUM LEUCOSTEGUM (Brid.) Mitt. Jour. Linn. Soc. Bot. **12**: 543. 1869

ST. JAN: Emaus, *Breutel;* Bethania, *Britton & Shafer 1357*. ST. THOMAS: on rocks in shade, ravine at Tutu, *1291*; waterfall near Magen's Bay, *1314*.

24. MITTENOTHAMNIUM DIMINUTIVUM (Hampe) E. G. Britton, Bryologist **17**: 9. 1914

ST. JAN: on dead wood, Bordeaux, 400 m. alt., *Britton & Shafer 595*.

25. TAXITHELIUM PLANUM (Brid.) Mitt. Jour. Linn. Soc. Bot. **12**: 496. 1869

ST. JAN: *Breutel;* Bethania, *Britton & Shafer 358, 365, 366;* Bordeaux, 400 m. alt., *Britton & Shafer 568, 580*. ST. THOMAS: St. Peter, *1259;* Crown Estate, *1366*. TORTOLA: High Bush, *Britton & Shafer 839*.

26. SEMATOPHYLLUM ADMISTUM (Sull.) Mitt. Jour. Linn. Soc. Bot. **12**: 485. 1869

ST. JAN: Bordeaux, 300 m. alt., *Britton & Shafer 554, 556, 578, 579*. ST. THOMAS: St. Peter, on rocks, *1257, 1457*. TORTOLA: High Bush, 375 m. alt., *Britton & Shafer 814, 840*.

27. SEMATOPHYLLUM SERICIFOLIUM Mitt. Jour. Linn. Soc. Bot. **12**: 483. 1869.

TORTOLA: on logs in forest, High Bush, 375 m. alt., *Britton & Shafer 819*

28. HAPLOCLADIUM MICROPHYLLUM (Sw.) Broth.; E. & P. Nat. Pfl. 1^3: 1007. 1907

ST. THOMAS: shaded bank, Pearl to Bonne Resolution, *1335*.

Explanation of plate 1

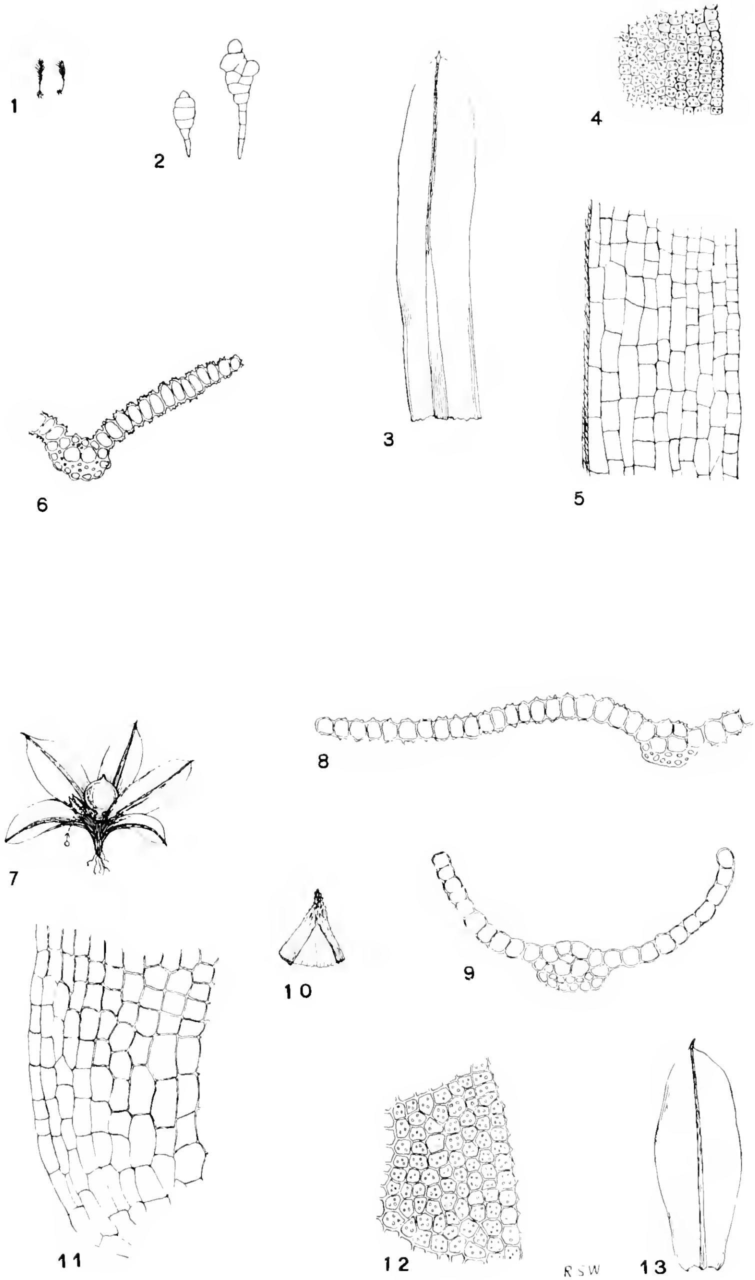
The figures were drawn by Mr. R. S. Williams from magnifications twice as great as expressed in the numbers, which represent the magnification of the figures as they stand in the reproduction.

HYOPHILA ULIGINOSA E. G. Britton

FIG. 1. Plant, natural size.
FIG. 2. Propagula, × 35.
FIG. 3. Upper leaf, × 35.
FIG. 4. Cells in upper part of leaf, × 200.
FIG. 5. Cells of leaf base, × 200.
FIG. 6. Cross section in upper part of leaf, × 200.

PHASCUM SESSILE E. G. Britton

FIG. 7. Plant, × 11.
FIG. 8. Cross-section in upper part of leaf × 200
FIG. 9. Cross-section near leaf base, × 200.
FIG. 10. Calyptra, × 35.
FIG. 11. Cells at basal angle, × 200.
FIG. 12. Cells in upper part of leaf, × 200.
FIG. 13. Upper leaf, × 20.



1–6. HYOPHILA ULIGINOSA E. G. Britton
7–13. PHASCUM SESSILE E. G. Britton

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 175

THE VEGETATION OF MONA ISLAND

A paper read by invitation at the Twenty-Fifth Anniversary Celebration of the Missouri Botanical Garden, October 15, 1914

NATHANIEL LORD BRITTON

ST. LOUIS
1915

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THE VEGETATION OF MONA ISLAND[1]

N. L. BRITTON
New York Botanical Garden

During the progress of the scientific survey of Porto Rico, organized by the New York Academy of Sciences with the aid of the American Museum of Natural History, the New York Botanical Garden and Columbia University, in coöperation with the Porto Rican Insular Government, exploration has been carried out not alone on the mainland of Porto Rico but on several small islands adjacent and politically a part of that colony. Two of these islands lie in the Mona Passage between Porto Rico and Santo Domingo, and being scientifically almost unknown, were made points of examination in February, 1914, when I visited them in company with Mr. John F. Cowell, Director of the Buffalo Botanic Garden, Dr. Frank E. Lutz, Assistant Curator of Invertebrate Zoölogy in the American Museum of Natural History, and Mr. W. E. Hess, Plant Propagator of the Porto Rico Agricultural Experiment Station at Mayaguez. The trip was made in a sloop chartered at Mayaguez.

Desecheo Island, lying about eighteen miles northwest of Mayaguez, was first visited, and explored during two days; this island is somewhat more than one square mile in area, bordered by rocky coasts, rising abruptly into several hills, and covered with low trees and shrubs. Its flora is essentially identical with that of the drier parts of Porto Rico and of Santo Domingo; the small tree *Morisonia americana* and the snowy cactus (*Mamillaria nivosa*) have, however, not yet been found on the Porto Rican mainland, although both occur on the Island of Culebra east of Porto Rico, and neither of them is known on Santo Domingo. The cactus *Opuntia haitiensis,* plentiful there, is otherwise known only in Hispaniola, and the shrub *Torrubia discolor* of Hispaniola and Cuba has not been found on Porto Rico. The collection made

[1] Issued May 17, 1915.

by us on Desecheo, together with one made by Professor F. L. Stevens and Mr. W. E. Hess in May, 1913, shows that the spermatophytes of Desecheo number about 90 species; further intensive exploration might reveal a few more. A single species of fern was seen, four species of mosses, and two species of hepatics. As there is no probability of this little island ever having been a part of the Porto Rico mainland, its plants must have reached it by natural agencies; there are probably as many fungi and lichens as of other land plants collectively, so the total land flora of Desecheo probably includes at least 200 species.

Mona Island, lying about thirty miles to the southwest of Desecheo, in the middle of the Mona Passage between Santo Domingo and Porto Rico, has an area of approximately twenty square miles. Prior to our visit, only one botanical collection had been made there, when it was visited by Professor F. L. Stevens in 1913, at which time he obtained specimens of about 150 species of flowering plants, and gave especial attention to the parasitic fungi. The considerable land area of this island made a complete knowledge of its flora desirable, from the standpoint of geographical distribution of West Indian plants, and we were able to devote five days to collecting. The greater portion of Mona is a limestone plateau elevated from 125 to 175 feet, the surface of this plateau being nearly level and devoid of hills; its soil is very sparse, consisting altogether of reddish loam in depressions of the limestone surface, and not of considerable extent at any point visited by us. The limestone is evidently very porous, and there are no streams or ponds, and only a single spring was seen; the limestone is honeycombed with caves and caverns, some of them of considerable size. The rainfall is evidently considerable, but there are no records of its amount. Despite the paucity of soil, the whole plateau is rather densely covered with shrubs and low trees of a considerable number of species, their roots, for the most part, penetrating into crevices of the limestone. Herbaceous vegetation is restricted to comparatively few species. Eight species of cacti inhabit this plateau, and in places are very abundant, the snowy cactus

(*Mamillaria nivosa*) being more plentiful here than on any other island visited by us; *Opuntia Taylori,* hitherto known from Hispaniola, Culebra and the Virgin Islands, was found as a single colony; this has not yet been detected on the Porto Rican mainland.

The limestone plateau of Mona is bordered nearly throughout by steep escarpments and is accessible at but few points, except along the southwestern side, where there is a low plain several miles long and averaging about half a mile wide, from which the plateau is reached at a number of points over a talus of large limestone blocks. At the foot of the escarpment and of the talus on this southwestern side, the moistest conditions of Mona occur, and several species of trees here reach large size, notably the manchioneel (*Hippomane Mancinella*) and two species of *Ficus.* Here also grow two species of ferns, several bryophytes, and a number of *Polyporaceae* infesting dead wood. The soil of the narrow plain is more abundant than that of the plateau, permitting agricultural operations on a small scale and supporting a low forest made up of a considerable number of kinds of trees, with more herbaceous vegetation than exists on the plateau. Among rare elements of this vegetation are two orchids, *Domingoa hymenodes,* hitherto known from Hispaniola and Cuba, and *Ibidium lucayanum,* of Porto Rico, Anagada and the Bahamas. The coastal sands, which extend almost uninterruptedly along the shore of the plain, are inhabited by characteristic West Indian sand-dune species.

Lichens are quite abundant on tree trunks and on rocks of the talus, including a considerable number of species. Professor Lincoln W. Riddle has examined the collection and has submitted the following report upon them:

"The exploration of Mona Island has yielded 42 numbers of lichens, 40 collected by Dr. N. L. Britton, Messrs. J. F. Cowell and W. E. Hess, and 2 collected incidentally by Dr. F. L. Stevens. These 42 numbers represent 26 species in condition for determination.

"The species growing on the limestone rocks constitute the most striking and interesting part of the collection. These include four species of *Omphalaria,* a species of *Collema,* and a species of the *Dermatocarpaceae,* which is, unfortunately, sterile and, therefore, not further determinable. The omphalarias are all little known species.

O. polyglossa Nyl., collected from limestone rocks in Cuba by Charles Wright, and not otherwise known, is apparently common on Mona Island, as it is represented by two numbers, each with several well-developed specimens. There occur also *O. lingulata* Tuck., previously known from Cuba and Bermuda; a sterile omphalaria related to *O. Wrightii* Tuck., but apparently not identical; and one other species of the genus, probably new. It has not yet been possible to identify the species of *Collema,* and that may also prove to be new. Curiously enough, none of these calciphile species has yet been detected among the material collected in Porto Rico.

"In marked contrast to the rock-lichens, the bark-inhabiting lichens are all common species, widely distributed in Tropical America. The genus *Trypethelium* is best represented, with the species *T. Eluteriae* (four numbers), *T. ochroleucum,* and its variety *pallescens,* and *T. mastoideum* (two numbers). There are also such characteristic species as *Graphis Afzelii, Melanotheca cruenta, Pyxine picta, Physcia alba* and *P. speciosa, Parmelia sulphurata* and *P. tinctorum,* and *Ramalina complanata* and *R. Montagnei.* Probably owing to the comparatively unfavorable conditions on Mona Island, the foliose and fruticose lichens are mostly small specimens, not well-developed."

The total flora of flowering plants, as indicated by the collection made by Professor Stevens and our own, includes about 230 species; some of them are found only in cultivated grounds on the coastal plain and have probably been introduced by man. The total flora of land cryptogams is probably as great or greater than that of flowering plants, so we may conclude that the land flora of Mona consists of as high as 500 species. So far as the investigation of the collections has proceeded, the only apparent endemic species are a *Chamaesyce,* which Dr. C. F. Millspaugh has described as new, a *Tabebuia,* the description of which is herewith included, and two very interesting riccias, here described by Dr. Marshall A. Howe. One or more of the lichens may be undescribed. Further exploration in Porto Rico and in Hispaniola may very well reveal their presence on these larger islands. It is interesting to have ascertained that the flora of this isolated limestone island is not more highly specialized. It is not necessary, in my opinion, to assume a former land connection between Mona and either Porto Rico or Santo Domingo, because all its native species may readily have reached it through natural agencies.

I append a list of the species collected as thus far determined, and have indicated in this list their known distribution, except that of the lichens and *Uredinales,* as regards Porto Rico, Curaçao, Hispaniola and the Bahamas, the nearest lands to Mona.

The names of new species, and new binomials, are printed in **heavy face** type.

List of Species inhabiting Mona Island

MONOCOTYLEDONS

VALOTA INSULARIS (L.) Chase
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

SYNTHERISMA DIGITATUM (Sw.) Hitchc.
Frequent in cultivated ground, coastal plain: Porto Rico; Hispaniola; Bahamas.

PASPALUM CAESPITOSUM Fluegge
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

PASPALUM SIMPSONI Nash
Collected by Professor Stevens, not found by us: Porto Rico; Bahamas.

PANICUM UTOWANAEUM Scribn.
Frequent on the coastal plain and on the plateau: Porto Rico; Desecheo; [Cuba; Guadeloupe].

PANICUM BARBINODE Trin.
Sandy soil, Playa de Fajaro: native of South America. Naturalized in the West Indies.

PANICUM ADSPERSUM Trin.
Moist soil, coastal plain: Porto Rico; Bahamas.

PANICUM MAXIMUM Jacq.
Frequent on the coastal plain: Native of tropical Africa; naturalized in the West Indies.

LASIACIS DIVARICATA (L.) Hitchc.
Frequent in thickets, coastal plain and plateau: Porto Rico; Hispaniola; Bahamas.

CHAETOCHLOA SETOSA (Sw.) Scribn.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CHAETOCHLOA CAUDATA (Lam.) Scribn.
Occasional on the coastal plain: Desecheo; [Jamaica; Cuba; St. Thomas].

CHAETOCHLOA IMBERBIS (Poir.) Scribn.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas.

CENCHROPSIS MYOSUROIDES (HBK) Nash
Frequent in cultivated ground on the coastal plain: Bahamas; Cuba.

CENCHRUS ECHINATUS L.
Common on the coastal plain and on sand dunes: Porto Rico; Hispaniola; Bahamas; Curacao.

CENCHRUS CAROLINIANUS Walt.
Collected by Professor Stevens, not found by us: Porto Rico; Hispaniola; Bahamas; Curacao.

ARISTIDA BROMOIDES HBK.
Common on the coastal plain: Porto Rico; Bahamas; Curacao.

SPOROBOLUS VIRGINICUS (L.) Beauv.
Common on coastal sands and on the coastal plain: Porto Rico; Hispaniola; Bahamas.

SPOROBOLUS ARGUTUS (Nees) Kunth
Frequent in moist soil on the coastal plain: Porto Rico; Hispaniola; Curacao.

CHLORIS PARAGUAIENSIS Steud.
Coastal plain, Sardinera: Porto Rico; Hispaniola; Bahamas; Curacao.

EUSTACHYS PETRAEA (Sw.) Desv.
Common on coastal sands and on the coastal plain: Porto Rico; Hispaniola; Bahamas.

ELEUSINE INDICA (L.) Gaertn.
Cultivated ground, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

DACTYLOCTENIUM AEGYPTIUM (L.) Willd.
Cultivated ground, coastal plain: Porto Rico: Hispaniola; Bahamas; Curacao.

PAPPOPHORUM LAGUROIDEUM Schrad.
Wet soil, coastal plain, between Sardinera and Ubero: Desecheo [Cuba; St. Eustatius].

ERAGROSTIS CILIARIS (L.) Link
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CYPERUS ELEGANS L.
Border of a marsh on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CYPERUS TENUIS Sw.
Occasional on the coastal plain: Porto Rico; Hispaniola.

CYPERUS LIGULARIS L.
Marsh, Sardinera: Porto Rico; Hispaniola; Bahamas; Curacao.

CYPERUS BRUNNEUS Sw.
Common on coastal sands: Porto Rico; Bahamas; Hispaniola; Curacao.

FIMBRISTYLIS SPATHACEA Roth.
Common on the coastal plain: Porto Rico; Bahamas; Hispaniola.

SCLERIA LITHOSPERMA (L.) Sw.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

? THRINAX PONCEANA O. F. Cook
Apparently this species, but determined from leaves only. Rare in thickets on the coastal plain, and not found either in flower or in fruit: Porto Rico.

TILLANDSIA UTRICULATA L.
Common on trees and on rocks: Porto Rico; Hispaniola; Bahamas; Curacao.

TILLANDSIA RECURVATA L.
Common on trees and shrubs: Porto Rico; Hispaniola; Bahamas; Curacao.

CALLISIA REPENS L.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola; Curacao.

COMMELINA VIRGINICA L. (*C. elegans* HBK.)
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

HYMENOCALLIS EXPANSA Herb.
Frequent in coastal sands. Determination from foliage only, therefore uncertain.

FURCRAEA TUBEROSA Ait. f.
Coastal plain between Sardinera and Ubero; probably introduced from Porto Rico. Determined from leaf specimens only: Porto Rico.

IBIDIUM LUCAYANUM Britton
Low woods, coastal plain near Sardinera: Porto Rico; Bahamas.

EPIDENDRUM PAPILIONACEUM Vahl
Common on shrubs and on the ground, coastal plain and plateau: Porto Rico; Hispaniola; recorded from the Bahamas.

DOMINGOA HYMENODES (Rchb. f.) Schltr.
On small trees between Sardinera and Ubero: Hispaniola [Cuba].

DICOTYLEDONS

PEPEROMIA HUMILIS (Vahl) A. Dietr.
Shaded limestone rocks near Sardinera. Plants with only the upper leaves opposite: Porto Rico; Hispaniola.

CELTIS TRINERVIA Lam.
Base of cliffs, Sardinera: Porto Rico; Hispaniola.

FICUS LAEVIGATA Vahl
Coastal plain and plateau; largest at the bases of cliffs: Porto Rico; Hispaniola.

FICUS STAHLII Warb.
Frequent along the bases of cliffs, eastern edge of the coastal plain. Trees up to 12 m. high. Determined from foliage only: Porto Rico.

CHLOROPHORA TINCTORIA (L.) Gaud.
Base of cliffs, Sardinera: Porto Rico; Hispaniola.

PILEA TRIANTHEMOIDES (Sw.) Lindl.
Frequent on the coastal plain: Porto Rico.

PILEA MICROPHYLLA (L.) Liebm.
Occasional on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

COCCOLOBIS UVIFERA (L.) Jacq.
Common on coastal sands and rocks: Porto Rico; Hispaniola; Bahamas; Curacao.

COCCOLOBIS OBTUSIFOLIA Jacq.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; ? Bahamas.

COCCOLOBIS LAURIFOLIA Jacq.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

COCCOLOBIS NIVEA Jacq.
Base of cliff, Sardinera: Porto Rico; Hispaniola.

AMARANTHUS TRISTIS L.
Waste and cultivated grounds on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

ACHYRANTHES INDICA (L.) Mill.
Frequent in cultivated ground, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

LITHOPHILA MUSCOIDES Sw.
Collected by Professor Stevens, not found by us: Porto Rico; Hispaniola; Bahamas; Curacao.

CELOSIA NITIDA Vahl
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas.

MIRABILIS JALAPA L.
Waste grounds, uncommon: Porto Rico; Hispaniola; Bahamas.

BOERHAAVIA COCCINEA Mill.
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

? PISONIA SUBCORDATA Sw.
Base of cliffs, Sardinera. Trees, 12 m. high or more, barren at the time of our visit and determination therefore uncertain: Porto Rico.

RIVINA HUMILIS L.
Common on the coastal plain on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

TRICHOSTIGMA OCTANDRUM (L.) H. Walt.
Frequent on the talus, vicinity of Sardinera, forming vines 20 m. long with trunks up to 1.5 dm. diameter: Porto Rico; Hispaniola.

PETIVERIA ALLIACEA L.
Occasional in thickets on the coastal plain: Porto Rico; Hispaniola; Bahamas.

SESUVIUM PORTULACASTRUM L.
Common on coastal rocks and sands: Porto Rico; Hispaniola; Bahamas; Curacao.

TALINUM PANICULATUM (Jacq.) Gaertn.
Coastal plain, Sardinera: Porto Rico; Hispaniola.

PORTULACA PHAEOSPERMA Urban
Moist soil, coastal plain and plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

PORTULACA OLERACEA L.
Sandy soil, Playa de Fajaro: Porto Rico; Hispaniola; Bahamas; Curacao.

NECTANDRA CORIACEA (Sw.) Griseb.
Base of limestone cliff, Sardinera: Porto Rico; Hispaniola; Bahamas; Curacao.

CASSYTHA AMERICANA Nees
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas.

CLEOME GYNANDRA L.
Waste and cultivated grounds, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CAPPARIS CYNOPHALLOPHORA L. (*C. jamaicensis* Jacq.)
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CAPPARIS FLEXUOSA L. (*C. cynophallophora* Jacq.)
Common on the coastal plain: Porto Rico: Hispaniola; Bahamas.

LEPIDIUM VIRGINICUM L.
Common in waste and cultivated ground: Porto Rico; Hispaniola; Bahamas.

BRASSICA INTEGRIFOLIA (West) O. E. Schulz
Occasional in cultivated ground, coastal plain: Porto Rico; Bahamas.

CAKILE LANCEOLATA (Willd.) O. E. Schulz
Common on coastal sands: Porto Rico; Hispaniola; Bahamas.

PITHECOLOBIUM UNGIUS-CATI (L.) Benth.
Common in coastal thickets and occasional on the coastal plain. All specimens examined were spineless: Porto Rico; Hispaniola; Bahamas; Curacao.

CASSIA OCCIDENTALIS L.
Sandy soil, Playa de Fajaro: Porto Rico; Hispaniola; Bahamas.

CHAMAECRISTA GRANULATA (Urban) Britton. (*Cassia portoricensis granulata* Urban.)
Common on the coastal plain and on sand dunes: Porto Rico.

CHAMAECRISTA DIFFUSA (DC.) Britton. (*Cassia diffusa* DC.)
Collected by Professor Stevens, not found by us: Porto Rico; Curacao.

? CAESALPINIA DOMINGENSIS Urban
On the plateau, Sardinera. Determined from description: Hispaniola.

GUILANDINA CRISTA (L.) Small
Occasional in coastal thickets: Porto Rico; Hispaniola; Bahamas.

GUILANDINA MELANOSPERMA (Urban) Britton. (*Caesalpinia melanosperma* Urban.)
Frequent on the coastal plain: St. Croix.

GUILANDINA DIVERGENS (Urban) Britton
Frequent on the coastal plain: Culebra [St. Thomas].

KRAMERIA IXINA L.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola; Curacao.

INDIGOFERA SUFFRUTICOSA Mill
Cultivated ground, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CRACCA CINEREA (L.) Morong
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

STYLOSANTHES HAMATA (L.) Taub.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

MEIBOMIA SUPINA (Sw.) Britton
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

MEIBOMIA MOLLIS (Vahl) Kuntze
Occasional in cultivated ground on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

BRADBURYA VIRGINIANA (L.) Kuntze
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

GALACTIA STRIATA (Jacq.) Urban
Frequent on the coastal plain and on the plateau. A race with small leaflets and slender-peduncled racemes: Porto Rico; Hispaniola.

CANAVALIA LINEATA (Thunb.) DC.
Common on coastal sands: Porto Rico; Hispaniola; Bahamas.

? DOLICHOLUS MINIMUS (L.) Medic
Cultivated ground, Ubero. A race apparently of this species, with thick leaflets, strongly veined; not found either in flower or in fruit, the determination, therefore, uncertain.

DOLICHOLUS RETICULATUS (Sw.) Millsp.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

ERYTHROXYLON AREOLATUM L.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

GUAIACUM SANCTUM L.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

ZANTHOXYLUM PUNCTATUM Vahl
Coastal plain between Sardinera and Ubero: Porto Rico; Hispaniola.

AMYRIS ELEMIFERA L.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

SURIANA MARITIMA L.
Common on coastal sands: Porto Rico; Hispaniola; Bahamas; Curacao.

ELAPHRIUM SIMARUBA (L.) Rose
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

STIGMAPHYLLON LINGULATUM (Poir.) Small
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola.

BYRSONIMA LUCIDA (Sw.) L. C. Rich
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

XYLOPHYLLA EPIPHYLLANTHUS (L.) Britton. (*Phyllanthus Epiphyllanthus* L.)
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas.

PHYLLANTHUS NIRURI L.
Cultivated ground, coastal plain. Not collected: Porto Rico; Hispaniola; Bahamas; Curacao.

CROTON LUCIDUS L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

CROTON DISCOLOR Willd.
Common on the plateau: Porto Rico; Hispaniola.

CROTON BETULINUS Vahl
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola.

ARGITHAMNIA CANDICANS Sw.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

RICINUS COMMUNIS L.
Waste grounds, Ubero: Native of the Old World tropics.

HIPPOMANE MANCINELLA L.
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CHAMAESYCE MONENSIS Millsp.
Limestone plateau, Ubero: Endemic.

CHAMAESYCE PORTORICENSIS (Urban) Millsp.
On limestone rocks, Ubero and Sardinera: Porto Rico.

CHAMAESYCE SERPENS (HBK.) Small
Moist soil, coastal plain and plateau: Porto Rico.

CHAMAESYCE HYPERICIFOLIA (L.) Millsp.
Common in cultivated ground on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CHAMAESYCE BUXIFOLIA (Lam.) Small
Common on coastal sands: Porto Rico; Hispaniola; Bahamas; Curacao.

AKLEMA PETIOLARIS (Sims) Millsp. (*Euphorbia petiolaris* Sims.)
Common on the coastal plain and on the plateau: Porto Rico.

POINSETTIA HETEROPHYLLA (L.) Kl. & Garcke
Sandy beach, Playa de Fajaro: Porto Rico; Hispaniola; Bahamas.

PEDILANTHUS LATIFOLIUS Millsp. & Britton, sp. nov.
Shrubby, about 6 feet high, the young branches zig-zag, puberulent. Leaves ovate to ovate-orbicular, 4.5 inches long or less, very nearly sessile, dull-green, acute at the apex, roundish or subcordate at the base, very inconspicuously veined, glabrous, the midrib elevated but not keeled beneath. Inflorescence terminal, cymose, puberulent, bracteate; bracts lanceolate, acute, 3.5–4 x 2 lin., somewhat exceeding the peduncles; involucre about 10 x 4.5 lin., glabrous without and within, tube narrow anteriorly, main lobes lanceolate-oblong, rounded obtuse, ciliate at the apex, the accessory lobes equal or nearly so connivent with the main lobes to near the ciliate apices, fifth lobe elongate-ligulate, truncate ciliate, somewhat shorter than the accessory lobes and nearly closing the superior fissure of the tube; appendix large, strongly saccate, about one-third the length of the tube, split for half its length into two sarcous, ligulate slightly grooved and emarginate lobes; glands 4, of two sorts: the upper pair reniform at the summit of a broadly triangular stipe which is connivent with the surface of the appendix, anterior margins free and sharp; lower pair about one-half the size of the upper, discoid, peltate on a very short, free pedicel. Male pedicels numerous, glabrous; female pedicel glabrous; ovary glabrous; style 3-lobed at the apex, the stigmatic branches bifid. Fruit unknown.

Castle Point, Bermuda (*Brown & Britton, 820,* TYPE). Near Bath, Jamaica (*Britton, 3491*). Baracoa, Cuba (*Bemis*). Sanchez, Santo Domingo (*Rose, Fitch & Russell, 4397*). Mona Island (*Britton, Cowell & Hess, 1786*). Perhaps indigenous at the Santo Domingo locality cited; at all the others an evident escape from cultivation, or in gardens.

METOPIUM TOXIFERUM (L.) Krug & Urban
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

COMOCLADIA DODONAEA (L.) Urban
Frequent on the plateau: Porto Rico; Hispaniola.

RHACOMA CROSSOPETALUM L.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

GYMINDA LATIFOLIA (Sw.) Urban
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

SCHAEFFERIA FRUTESCENS Jacq.
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas.

CARDIOSPERMUM MICROCARPUM HBK.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

HYPELATE TRIFOLIATA Sw.
Coastal plain near Sardinera: Porto Rico; Hispaniola; Bahamas.

EXOTHEA PANICULATA (Juss.) Radlk.
Base of limestone cliffs, Sardinera: Porto Rico; Hispaniola; Bahamas.

DODONAEA EHRENBERGII Schl.
Common on the coastal plain and on the plateau: Hispaniola; Bahamas.

KRUGIODENDRON FERREUM (Vahl) Urban
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

REYNOSIA UNCINATA Urban
Frequent on the plateau: Porto Rico.

SARCOMPHALUS TAYLORI Britton
Occasional on the coastal plain: Bahamas.

COLUBRINA COLUBRINA (L.) Millsp.
Occasional along the base of the cliffs, coastal plain: Porto Rico; Hispaniola; Bahamas.

CISSUS TRIFOLIATA L.
Coastal thickets: Porto Rico; Hispaniola; Bahamas; Aruba.

CORCHORUS SILIQUOSUS L.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

CORCHORUS HIRSUTUS L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

ABUTILON UMBELLATUM (L.) Sweet
Frequent on the coastal plain: Porto Rico; Hispaniola; Curacao.

GAYOIDES CRISPUM (L.) Small
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

MALVASTRUM SPICATUM (L.) A. Gray
Cultivated ground, coastal plain: Porto Rico; Hispaniola; Curacao.

SIDA SPINOSA L.
Cultivated ground, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

SIDA GLABRA Mill. (*S. ulmifolia* Cav.)
Frequent on the coastal plain: Porto Rico; Hispaniola.

SIDA PROCUMBENS Sw.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

SIDA ACUMINATA DC.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

BASTARDIA VISCOSA (L.) HBK.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas; recorded from Curacao.

MALACHRA CAPITATA L.
Occasional in cultivated ground, coastal plain: Porto Rico; Hispaniola.

PARITIUM TILIACEUM (L.) Juss.
Border of a swamp, Sardinera: Porto Rico; Hispaniola; Bahamas.

GOSSYPIUM BARBADENSE L.
Spontaneous after cultivation on the coastal plain. Apparently not native.

MELOCHIA TOMENTOSA L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

WALTHERIA AMERICANA L.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

AYENIA PUSILLA L.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas.

HELICTERES JAMAICENSIS Jacq.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

CLUSIA ROSEA Jacq.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

CANELLA WINTERANA (L.) Gaertn.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

TURNERA DIFFUSA Willd.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

PASSIFLORA SUBEROSA L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

PASSIFLORA FOETIDA L.
Sandy beach, Playa de Fajaro: Porto Rico; Hispaniola; Bahamas; Curacao.

CARICA PAPAYA L.
Common on the coastal plain about Sardinera, apparently established after cultivation. A race with small globose fruits. Original home unknown.

HARRISIA PORTORICENSIS Britton
Common on the talus and on the plateau: Porto Rico.

CEPHALOCEREUS ROYENI (L.) Britton & Rose
Common on the plateau: Porto Rico [St. Thomas to Antigua].

CACTUS INTORTUS Mill. (*Melocactus portoricensis* Suringar.)
Common on the plateau: Porto Rico [St. Thomas to Antigua].

CORYPHANTHA NIVOSA (Link) Britton. (*Mamillaria nivosa* Link.)
Very abundant on the plateau: Culebra [St. Thomas to Tortola; Antigua]; Bahamas.

OPUNTIA CATACANTHA Link & Otto
Common on the plateau; occasional on the coastal plain: Porto Rico [St. Thomas to Antigua].

OPUNTIA TAYLORI Britton
Top of cliff near Sardinera: Santo Domingo; Culebra [St. Thomas to Tortola].

OPUNTIA DILLENII (Ker.) Haw.
Common on the coastal plain and on the plateau. Not collected: Porto Rico; Hispaniola; Bahamas.

TERMINALIA CATAPPA L.
Occasional on coastal sands: Porto Rico; Hispaniola; [spontaneous after cultivation in the Bahamas].

CONOCARPUS ERECTA L.
Occasional in coastal sands: Porto Rico; Hispaniola; Bahamas; Curacao.

BUCIDA BUCERAS L.
Coastal woods, Ubero: Porto Rico; Hispaniola; Bahamas.

LAGUNCULARIA RACEMOSA (L.) Gaertn.
Borders of marshes, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CALYPTRANTHES PALLENS (Poir.) Griseb.
Base of cliffs, Ubero: Porto Rico (?); Hispaniola; Bahamas.

EUGENIA BUXIFOLIA (Sw.) Willd.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

EUGENIA AXILLARIS (Sw.) Willd.
Frequent or occasional on the coastal plain, at the base of cliffs and on the plateau: Porto Rico; Hispaniola; Bahamas.

EUGENIA RHOMBEA (Berg.) Krug. & Urban
Coastal plain between Sardinera and Ubero: Porto Rico; Hispaniola; Bahamas.

ANAMOMIS FRAGRANS (Sw.) Griseb.
Occasional on the coastal plain: Porto Rico; Hispaniola. Recorded from the Bahamas.

JACQUINIA BARBASCO (Loefl.) Mez.
Common in coastal thickets and occasional on the coastal plain: Porto Rico; Hispaniola; Curacao.

? DIPHOLIS
Coastal plain, Sardinera. A tree about 12 m. high, in foliage only.

BUMELIA OBOVATA (Lam.) DC.
Frequent on the coastal plain. Not in flower or fruit at the time of our visit: Porto Rico; Hispaniola; Curacao.

PLUMIERA OBTUSA L.
Common on the coastal plain and on the plateau: Hispaniola; Bahamas.

RAUWOLFIA TETRAPHYLLA L. (*R. nitida* Jacq.)
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

ECHITES AGGLUTINATA Jacq.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola.

URECHITES LUTEA (L.) Britton
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

METASTELMA (undetermined)
Coastal rocks, Ubero.

METASTELMA (undetermined)
Occasional on the coastal plain and on the plateau.

EVOLVULUS GLABER Spreng.
Moist soil, coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

JACQUEMONTIA JAMAICENSIS (Jacq.) Hall. f.
Occasional on coastal sands: Porto Rico; Hispaniola; Bahamas.

JACQUEMONTIA PENTANTHA (Jacq.) D. Don
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

OPERCULINA AEGYPTIA (L.) House
Cultivated ground, coastal plain: Porto Rico; Hispaniola; Curacao.

? EXOGONIUM MICRODACTYLUM (Griseb.) House
Occasional on the plateau. Specimen insufficient for certain determination.

IPOMOEA PES-CAPRAE (L.) Roth.
Common on coastal sands: Porto Rico; Hispaniola; Bahamas; Curacao.

IPOMOEA TRILOBA L.
Frequent in cultivated ground on the coastal plain: Porto Rico; Bahamas.

CALONYCTION GRANDIFLORUM (Jacq.) Choisy. (*Ipomoea tuba* G. Don.)
Frequent in coastal thickets: Porto Rico; Hispaniola; Bahamas; Curacao.

VARRONIA GLOBOSA Jacq.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

BOURRERIA SUCCULENTA Jacq.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Curacao.

MALLOTONIA GNAPHALODES (L.) Britton.[1] (*Tournefortia gnaphalodes* R. Br.)
Common on coastal sands: Porto Rico; Hispaniola; Bahamas; Curacao.

TOURNEFORTIA HIRSUTISSIMA L.
Base of limestone cliffs, Sardinera: Porto Rico; Hispaniola.

TOURNEFORTIA MICROPHYLLA Bert.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola.

HELIOTROPIUM CRISPIFLORUM Urban
Moist soil, coastal plain: Porto Rico. Closely resembles the Porto Rico plant but is lower and with shorter internodes; no flowering specimens were obtained.

HELIOTROPIUM PARVIFLORUM L.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

LANTANA SCABRIDA Ait.
Collected by Professor Stevens, not found by us: Porto Rico; Hispaniola. Apparently specifically distinct from *L. Camara* L.

LANTANA INVOLUCRATA L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

VALERIANODES JAMAICENSIS (L.) Medic
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

VALERIANODES STRIGOSA (Vahl) Kuntze
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola.

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[1]**Mallotonia** (Griseb.) Britton, gen. nov.
Tournefortia Section *Mallotonia* Griseb. Fl. Brit. W. I. 483. 1861.
Type species: *Tournefortia gnaphalodes* (L.) R. Br.

SALVIA SEROTINA L. (*S. micrantha* Vahl)
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

HYPTIS PECTINATA (L.) Poit.
Cultivated ground on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

SOLANUM NIGRUM L. (*S. americanum* Mill.)
Cultivated ground, Sardinera: Porto Rico; Hispaniola; Bahamas; Curacao.

SOLANUM VERBASCIFOLIUM L.
Occasional at the bases of cliffs and on the coastal plain: Porto Rico; Hispaniola; Bahamas.

BRAMIA MONNIERIA (L.) Drake. (*Herpestis Monniera* HBK.)
Border of a pool, Sardinera: Porto Rico; Hispaniola; Bahamas.

CAPRARIA BIFLORA L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

SCOPARIA DULCIS L.
In moist soil on the coastal plain: Porto Rico; Hispaniola; Bahamas.

TABEBUIA HETEROPHYLLA (DC.) Britton. (*Raputia* (?) *heterophylla* DC.; *Tabebuia triphylla* DC., not *Bignonia triphylla* L.)
Frequent on the coastal plain and on the plateau. Leaves 1-foliolate to 5-foliolate: Porto Rico.

TABEBUIA LUCIDA Britton, sp. nov.
A tree up to 5 m. high. Leaves 3–5-foliolate; petioles slender, lepidote, 6 cm. long or less; petiolules of the larger, upper leaflets slender, lepidote, 8–20 mm. long; lower leaflets sessile or nearly so; leaflets thin-coriaceous, narrowly oblong or oblong-oblanceolate, 5–10 cm. long, 1–3 cm. wide, shining, reticulate-veined and lepidote on both sides, rather abruptly acute or obtusish at the apex, narrowed or obtuse at the base; flowers clustered; pedicels lepidote; calyx about 14 mm. long, 2-lipped; corolla pink, glabrous, about 5 cm. long, its cylindric tube 5–6 mm. long, its narrowly campanulate throat about 3 cm. long, its limb about 1.5 cm. long, the lobes nearly entire.
Limestone cliffs, Sardinera, Mona Island, Porto Rico (*Britton, Cowell and Hess, 1686*).

SESAMUM ORIENTALE L.
Cultivated ground, coastal plain. Native of the East Indies.

BLECHUM BROWNEI Juss.
Shaded rocks, Sardinera: Porto Rico; Hispaniola; Bahamas.

JUSTICIA PERIPLOCIFOLIA Jacq.
Occasional on the coastal plain, a narrow-leaved race: Porto Rico; Hispaniola.

JUSTICIA PECTORALIS Jacq.
Border of pool, Sardinera: Porto Rico; Hispaniola.

PLANTAGO MAJOR L.
Cultivated ground, coastal plain. Not collected. Native of the Old World.

EXOSTEMA CARIBAEUM (Jacq.) R. & S.
Frequent on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

RANDIA ACULEATA L.
Common on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

GUETTARDA ELLIPTICA Sw.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

STENOSTOMUM ACUTATUM DC.
Frequent on the coastal plain and on the plateau: Porto Rico; Curacao.

ERITHALIS FRUTICOSA L.
Common on sand dunes, on the coastal plain and occasional on the plateau: Porto Rico; Hispaniola; Bahamas; Curacao.

CHIOCOCCA ALBA (L.) Hitchc.
Occasional on the coastal plain and on the plateau: Porto Rico; Hispaniola; Bahamas.

STRUMPFIA MARITIMA Jacq.
Limestone plateau near Ubero, frequent: Porto Rico; Hispaniola; Bahamas; Curacao.

PSYCHOTRIA UNDATA Jacq.
Occasional on the coastal plain: Porto Rico; Hispaniola; Bahamas.

ERNODEA LITTORALIS Sw.
Common on coastal sands: Porto Rico; Hispaniola; Bahamas; Bonaire.

SPERMACOCE TENUIOR L.
Frequent on the coastal plain: Porto Rico; Hispaniola; Bahamas; Curacao.

CUCUMIS ANGURIA L.
Cultivated ground, Sardinera: Porto Rico; Hispaniola; Curacao.

EUPATORIUM ODORATUM L.
Common on the coastal plain: Porto Rico; Hispaniola; Bahamas.

EUPATORIUM ATRIPLICIFOLIUM Lam.
Coastal rocks, Sardinera: Porto Rico; recorded from Hispaniola and from the Bahamas.

LEPTILON PUSILLUM (Nutt.) Britton
Common in waste and cultivated grounds, coastal plain: Porto Rico; Hispaniola (?); Bahamas.

LEPTILON BONARIENSE (L.) Small
Cultivated ground, Sardinera: Porto Rico; Hispaniola.

PLUCHEA PURPURASCENS (Sw.) DC.
Borders of marshes, coastal plain: Porto Rico; Hispaniola; Bahamas.

BORRICHIA ARBORESCENS (L.) DC.
Occasional on coastal rocks: Porto Rico; Hispaniola; Bahamas.

WEDELIA PARVIFLORA L. C. Rich
Common on the coastal plain: Porto Rico.

ELEUTHERANTHERA RUDERALIS (Sw.) Sch. Bip.
Cultivated ground, coastal plain: Porto Rico; Hispaniola. Erroneously recorded from the Bahamas.

BIDENS CYNAPIIFOLIA HBK.
Collected by Professor Stevens, not found by us: Porto Rico; Hispaniola; Bahamas; Curacao.

PTERIDOPHYTA

(Determined by Miss Margaret Slosson)

ADIANTUM FRAGILE Sw.
Limestone cliff, Sardinera: Porto Rico; Hispaniola.

ACROSTICHUM AUREUM L.
Border of pool near Sardinera. Determined from barren leaf specimen: Porto Rico; Hispaniola; Bahamas; Curacao.

CYCLOPELTIS SEMICORDATA (Sw.) J. Smith
Shaded limestone rocks, Sardinera: Porto Rico; Hispaniola.

MUSCI

(Determined by Elizabeth G. Britton and R. S. Williams)

THUIDIUM INVOLVENS (Hedw.) Mitt.
On dead wood and shaded rocks: Porto Rico; Hispaniola.

TORTULA AGRARIA Sw.
On the ground near Sardinera: Porto Rico; Hispaniola; Bahamas.

HYOPHILA GUADELUPENSIS Broth.
Wet soil on the coastal plain between Sardinera and Ubero: Guadeloupe; Montserrat.

BRYUM MICRODECURRENS E. G. Britton
Wet soil on the coastal plain between Sardinera and Ubero: St. Thomas.

CALYMPERES RICHARDI C. Muell.
On tree trunks, base of cliff, Sardinera: Porto Rico; Hispaniola; Bahamas.

CALYMPERES (an apparently undescribed species)
On *Bourreria*, Ubero; Hispaniola.

HEPATICAE

JUNGERMANNIACEAE

(Determined by Professor A. W. Evans)

BRACHIOLEJEUNEA BAHAMENSIS Evans
On limestone, Ubero; on trunk of *Gymnanthes*, Sardinera: Bahamas.

MASTIGOLEJEUNEA AURICULATA (Wils. & Hook.) Schiffn.
On shaded limestone and on dead wood, Sardinera: Porto Rico; Bahamas.

LEJEUNEA (barren and undeterminable)
On shaded limestone, bark and dead wood.

FRULLANIA SQUARROSA (R. B. & U.) Dumort.
On trunks and logs on the coastal plain: Porto Rico; Bahamas.

FRULLANIA (barren and undeterminable)
On dead wood, Sardinera.

RICCIACEAE

(Contributed by Dr. Marshall Avery Howe)

RICCIA BRITTONII, sp. nov.
Thallus simple or once dichotomous, forming irregularly gregarious patches, oblong-ovate, linguiform, or obovate, 2–5 mm. x 1–2 mm., subacute or obtuse, conspicuously alveolate-reticulate and light green above, with a scarious-albescent border 80–175 μ wide, concolorous or very commonly brownish laterally and ventrally; median sulcus deep and acute except in older parts; ventral scales small, inconspicuous, hyaline, rarely exceeding the thin membranous ascending thallus-margins; transverse sections mostly 1.5–2.0 times as wide as high, the ventral outlines semi-orbicular in younger parts, becoming flattened in the older; cells of the primary dorsal epidermis cylindric dome-shaped or subhemispheric, soon collapsing, leaving shallow slightly indurated more or less persistent cup-like vestiges; monoecious; antheridial ostioles scarcely elevated; spores brown, becoming subopaque, soon exposed, 100–145 μ in maximum diameter, rather ob-

scurely or sometimes distinctly angled, often flattened, destitute of wing-margins, almost uniformly areolate over the whole surface, with age showing in profile obtuse or truncate papillae 3–5 μ long, areolae mostly 10–18 μ wide.

On wet, sunny soil, accompanied by *R. violacea*, between Sardinera and Ubero, Mona Island, February, 1914, *Britton, Cowell, & Hess, 1749a.*

Riccia Brittonii exhibits certain points of contact with *Riccia sorocarpa* Bisch. and *R. dictyospora* M. A. Howe.[1] It is close to *R. sorocarpa* in vegetative characters, though differing in the wider, more pronounced, scarious-albescent thallus-margins and slightly in the character of the epidermis, but it departs widely from this species in the spores, which are much larger (100–145 μ *vs.* 70–90 μ, max. diam.), are destitute of wing-margins, and commonly have the areolae of the inner faces almost as well and regularly developed as those of the outer face. From *Riccia dictyospora*, the species differs in the less elongate thallus (2–5 mm. *vs.* 4–10 mm.), the albescent instead of dark purple thallus-margins and scales, the more semicircular and less parabolic outlines of transverse sections of the thallus, and in the larger spores (100–145 μ *vs.* 95–116 μ, max. diam.), with larger areolae (10–18 μ *vs.* 8–12 μ.

RICCIA VIOLACEA, sp. nov.

Thallus simple or 1–3 times dichotomous, irregularly gregarious, 1.5–4.0 mm. long, the main segments oblong-obovate or linguiform, 0.65–1.15 mm. broad, rather obscurely and finely areolate and dark green above, dark violet or blackish at margins and on sides, this color encroaching on the surface here and there, especially in the older parts and at the sinuses; median sulcus shallow or obsolete except at apex; ventral scales very short or rudimentary, dark violet, rarely overlapping, commonly divided into a series of small irregular often tooth-like lamellae, each consisting of only a few cells; transverse sections plano-convex, somewhat flattened-semiorbicular, or occasionally biconvex, 1.5–2.0 times as wide as high; the margins obtuse or rounded, bearing especially toward the apex numerous or occasional violet or sometimes hyaline conic or subcylindric acute or obtuse papillae 30–110 μ long and 25–45 μ broad at base; cells of the primary dorsal epidermis subhemispheric or mammiform, soon collapsing and leaving inconspicuous vestigia; remaining parts unknown.

On wet, sunny soil, accompanied by *Riccia Brittonii*, between Sardinera and Ubero, Mona Island, February, 1914, *Britton, Cowell, & Hess, 1749b.*

In size, habit, and color, *R. violacea* is somewhat suggestive of *R. nigrella* DC., but the thallus has papillae or very short cilia at the margins, which are wanting in *R. nigrella*, the scales are much smaller, more rudimentary and more divided than in *R. nigrella*, and the cells of the primary epidermis are much less persistent. Its nearest affinity is doubtless with *R. atromarginata* Levier, which is known from Sicily, Sardinia, and Greece; from this it appears to differ (if one may judge from the descriptions alone) in the obtuse thallus-margins, the very short, rudimentary, divided, rarely overlapping scales, and the commonly violet papillae which are confined to the margins and sides while in *R. atromarginata* the hyaline incurved "pili" are said to cover also the anterior dorsal surface.

LICHENES

(Determined by Professor Lincoln W. Riddle)

ARTHOPYRENIA

On *Coccolobis obtusifolia*, Ubero.

PYRENULA

On bark, Sardinera.

MELANOTHECA CRUENTA (Mont.) Muell. Arg.

On *Gymnanthes*, Sardinera.

TRYPETHELIUM ELUTERIAE Spreng.

On *Pithecolobium*, Sardinera, and on *Coccolobis obtusifolia*, Ubero.

[1]Bull. Torr. Bot. Club **28**: 163. 1901.

TRYPETHELIUM MASTOIDEUM Ach.
On *Pithecolobium*, Sardinera.

TRYPETHELIUM OCHROLEUCUM Nyl.
On *Zanthoxylum*, between Sardinera and Ubero.

OPEGRAPHA
On *Ficus*, Sardinera; on *Calyptranthes*, Ubero.

GRAPHIS AFZELII Ach.
On *Zanthoxylum*, between Sardinera and Ubero; on *Pithecolobium*, Sardinera.

GRAPHIS
Collected by Professor Stevens.

CHIODECTON
On *Plumicra*, Sardinera.

LEPTOTREMA
On dead wood, Sardinera.

CLADONIA FIMBRIATA var. CONIOCRAEA (Floerke) Wainio
On dead log, Sardinera.

OMPHALARIA LINGULATA Tuck.
On limestone, Sardinera.

OMPHALARIA POLYGLOSSA Nyl.
On exposed limestone, Ubero.

OMPHALARIA
On limestone, Ubero.

COLLEMA
On limestone rocks, Sardinera.

LEPTOGIUM (sterile and indeterminable)
On *Torrubia*, Sardinera.

PARMELIA TINCTORUM Despv.
On a tree trunk.

PARMELIA SULPHURATA Nees and Flot.
On a dead log, Sardinera.

RAMALINA MONTAGNEI De Not.
On a twig, Sardinera. Collected also by Professor Stevens.

RAMALINA COMPLANATA (Sw.) Ach.
On a twig, Sardinera.

PYXINE PICTA (Sw.) Tuck.
On *Pithecolobium*, Sardinera; on *Zanthoxylum*, between Sardinera and Ubero.

PHYSCIA SPECIOSA (Wulf.) Nyl. (A small form)
On *Ficus*, Sardinera.

PHYSCIA ALBA Fee
On *Calyptranthes*, Ubero; also, not typical, on *Torrubia*, Sardinera.

The collection also contains a sterile plant near *Omphalaria Wrightii* Tuck., from wet, sunny soil between Sardinera and

Ubero, a sterile species of the *Dermatocarpaceae* growing on limestone at Ubero, and three other sterile and undeterminable specimens.

BASIDIOMYCETES
(Determined by Dr. W. A. Murrill)

LENTINUS CRINITUS (L.) Fries
On dead wood, Ubero: Porto Rico; Bahamas.

SCHIZOPHYLLUM ALNEUM (L.) Schroet.
Frequent on dead wood: Porto Rico; Bahamas.

DAEDALEA AMANITOIDES Beauv.
On dead wood, Ubero: Porto Rico; Bahamas.

INONOTUS CORROSUS Murr.
On dead wood, Sardinera: Porto Rico; Bahamas.

PYROPOLYPORUS DEPENDENS Murr.
On dead wood: Porto Rico; Bahamas.

POGONOMYCES HYDNOIDES (Sw.) Murr.
On dead wood: Porto Rico; Bahamas.

PYCNOPORUS SANGUINEUS (L.) Murr.
Frequent on dead wood at base of escarpment: Porto Rico; Bahamas.

CORIOLOPSIS RIGIDA (Berk. & Mont.) Murr.
On dead wood, Sardinera: Porto Rico; Bahamas.

CORIOLUS PINSITUS (Fries) Pat.
On dead wood: Porto Rico; Bahamas.

XYLARIA
On dead log, Ubero.

UREDINALES
(Determined by Professor J. C. Arthur)

COLEOSPORIUM PLUMIERAE Pat.
On *Plumiera obtusa.*

KUEHNEOLA GOSSYPII (Lagerh.) Arth.
On *Gossypium barbadense.*

PUCCINIA CENCHRI Dietr. & Holw.
On *Cenchrus.*

PUCCINIA CRASSIPES B. & C.
On *Ipomoea triloba* L.

PUCCINIA EUPHORBIAE P. Henn.
On *Aklenea petiolaris* (Sims) Millsp.

PUCCINIA INFLATA Arth.
On *Stigmaphyllon lingulatum* (Poir.) Small

PUCCINIA LATERITIA B. & C.
On *Ernodea littoralis* Sw.

PUCCINIA URBANIANA P. Henn.
On *Valerianodes strigosa* (Vahl) Kuntze

UREDO BIOCELLATA Arth.
On *Pluchea purpurascens* (Sw.) Kuntze

UREDO CAMELIAE Mayor.
On *Chaetochloa setosa.*

Many parasitic fungi collected by Professor Stevens have not yet been determined.

ALGA

(Determined by Professor N. Wille)

SCYTONEMA OCELLATUM Lyngb.
Flat limestone plateau, Ubero.

Recapitulation

Species indicated in the foregoing list		292
Deduct thallophytes (distribution little known)		47
		245
Deduct undetermined and doubtfully determined species		12
		233
Deduct certainly introduced species		8
		225
Deduct endemic species		4
		221
In common with Porto Rico	211	
" " " Hispaniola	185	
" " " Bahamas	155	
" " " Curacao	87	

Species other than Endemic Ones and Thallophytes not known on Porto Rico (including Desecheo, Culebra and Vieques)

Cenchropsis myosuriodes: Bahamas; Cuba.
Domingoa hymenodes: Hispaniola; Cuba.
Caesalpinia domingensis: Hispaniola.
Guilandina melanosperma: St. Croix.
Dodonaea Ehrenbergii: Bahamas; Hispaniola; Cuba.

Sarcomphalus Taylori: Bahamas.
Plumiera obtusa: Hispaniola; Bahamas; Cuba.
Brachiolejeunea bahamensis: Florida; Bahamas.
Hyophila guadelupensis: Guadeloupe; Montserrat.
Bryum subdecurrens: St. Thomas.

Explanation of Plate

PLATE 1

Fig. 1. Escarpment, Mona Island, showing openings of caves.

Fig. 2. Part of Mona Island from the ocean, showing escarpments and plateau.

Fig. 1

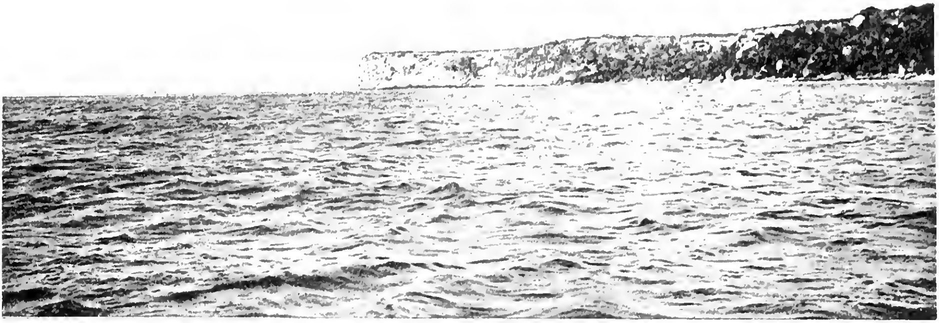

Fig. 2

BRITTON—VEGETATION OF MONA ISLAND

Explanation of Plate

PLATE 2

Fig. 1. Escarpment and tables, Mona Island.
Fig. 2. Coastal thicket, Mona Island.

Fig. 1

Fig. 2

BRITTON—VEGETATION OF MONA ISLAND